

# Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat



**Wheat Data Interoperability Working Group (WDIWG)**  
**Research Data Alliance (RDA)**  
*February 2015*

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## Background

The following questionnaire "Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat" has been prepared by the Wheat Data Interoperability Working Group (WDIWG)<sup>1</sup> of the Research Data Alliance (RDA)<sup>2</sup>.

The goal of the WDIWG is to provide a common framework for describing, representing, linking and publishing Wheat Research with respect to open data standards. To achieve this goal, we ask for the collaboration of developers, curators and managers of ontologies and vocabularies which could be used for data annotation in the Wheat Research area.

The aim of the survey is to collect to information about the visibility, interoperability, domain, content and other technical aspects of relevant ontologies and vocabularies. The information collected will be used in recommendations to wheat researchers around the world.

**General answers: 21**

**Number of complete answers: 21**

## Summary

|                                      |       |
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| General information.....             | 3-14  |
| Visibility and interoperability..... | 15-28 |
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<sup>1</sup> <https://rd-alliance.org/groups/wheat-data-interoperability-wg.html>

<sup>2</sup> <https://rd-alliance.org/>

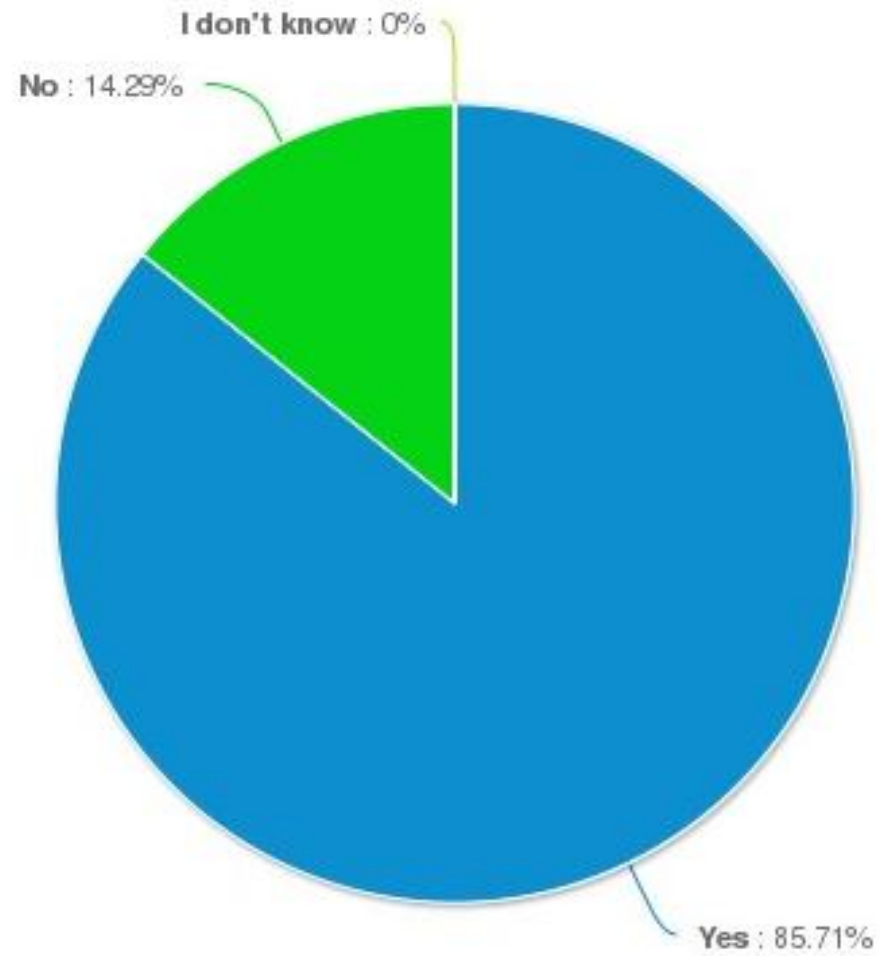
| 1. Name of the ontology or vocabulary           | 2. Alternative name or acronym | 3. Contact person (First) | 4. Contact e-mail           | 5. URL(s) of the ontology or vocabulary   | 6. Who or what organization is supporting the ontology or vocabulary?  |
|---|--------------------------------|---------------------------|-----------------------------|---|--|
| <b>AGROVOC</b>                                  | <b>AGROVOC</b>                 | Caterina Caracciolo       | caterina.caracciolo@fao.org | aims.fao.org/agrovoc  | Food and Agriculture Organization of the UN  |
| <b>CAB Thesaurus</b>                            | <b>CABT</b>                    | Anton Doroszenko          | a.doroszenko@cabi.org       | <a href="http://www.cabi.org/cabthesaurus/">http://www.cabi.org/cabthesaurus/</a>   | CAB International, Nosworthy Way, Wallingford, Oxfordshire, UK, OX10 8DE. Also contributing to GACS (Global Agricultural Concept Scheme) in collaboration with FAO and USDA National Agricultural Library.   |
| <b>Cell Ontology</b>                            | <b>Cell Type Ontology, CL</b>  | Alexander Diehl           | addiehl@buffalo.edu         | <a href="http://purl.obolibrary.org/obo/cl.owl">http://purl.obolibrary.org/obo/cl.owl</a> , <a href="https://code.google.com/p/cell-ontology/">https://code.google.com/p/cell-ontology/</a> | NIAID is providing limited support for curation of hematopoietic cell types in CL. Additional curation is provided by the GO Consortium, ZFIN, and other model organism databases as needed for their own purposes. Please note that the Plant Ontology is responsible for the curation of plant cell types. |
| <b>Chemical Entities of Biological Interest</b> | <b>ChEBI</b>                   | Janna Hastings            | hastings@ebi.ac.uk          | <a href="http://www.ebi.ac.uk/chebi/">http://www.ebi.ac.uk/chebi/</a>   | European Molecular Biology Laboratory -- European Bioinformatics Institute (EMBL-EBI), Cheminformatics and Metabolism group.   |
| <b>Crop Ontology</b>                            | <b>CO</b>                      | Elizabeth Arnaud          | e.arnaud@cgiar.org          | <a href="http://www.cropontology.org/">http://www.cropontology.org/</a>   | the Integrated Breeding Platform; Bioversity International; CGIAR  |
| <b>Environment Ontology</b>                     | <b>ENVO</b>                    | Pier Luigi Buttigieg      | p.buttigieg@gmail.com       | <a href="http://www.environmentontology.org">www.environmentontology.org</a>  | An international group of domain and technical experts and contributors support the ontology with their input and usage. Due to the early-adoption of ENVO by the genomics community, the project was included under the umbrella of the Genomic Standards Consortium.                                       |

| 1. Name of the ontology or vocabulary                   | 2. Alternative name or acronym                                 | 3. Contact person (First) | 4. Contact e-mail               | 5. URL(s) of the ontology or vocabulary  | 6. Who or what organization is supporting the ontology or vocabulary?   |
|---|--|---------------------------|---------------------------------|--|---|
| <b>Experimental Factor Ontology</b>                     | <b>EFO</b>   | James Malone              | malone@ebi.ac.uk                | <a href="http://www.ebi.ac.uk/efo/">www.ebi.ac.uk/efo/</a>   | European Bioinformatics Institute   |
| <b>Feature Annotation Location Description Ontology</b> | <b>FALDO</b>   | Jerven bolleman           | jerven.bolleman@isb-sib.ch      | <a href="http://biohackathon.org/resource/faldo">http://biohackathon.org/resource/faldo</a>  | Swiss Institute of Bioinformatics   |
| <b>NAL Thesaurus</b>                                    | <b>NALT</b>  | Sujata Suri               | sujata.suri@ars.usda            | <a href="http://agclass.nal.usda.gov">http://agclass.nal.usda.gov</a>  | National Agricultural Library, Agricultural Research Services, USDA   |
| <b>Phenotype And Trait Ontology</b>                     | <b>PATO</b>  | Georgios Gkoutos          | g.gkoutos@gmail.com             | <a href="http://www.obofoundry.org/cgi-bin/detail.cgi?id=quality">http://www.obofoundry.org/cgi-bin/detail.cgi?id=quality</a>  | PATO is part of the OBO foundry and is currently maintained without a specific grant.   |
| <b>Plant Experimental Conditions Ontology</b>           | <b>Plant Environment Ontology, EO, may be changing to PECO</b> | Laurel Cooper             | cooperl@science.oregonstate.edu | Dev: <a href="http://crop-dev.cgrb.oregonstate.edu/amigo/EO">http://crop-dev.cgrb.oregonstate.edu/amigo/EO</a> ; Live: <a href="http://planteome.org">http://planteome.org</a> | The Plant Experimental Conditions Ontology was originally started as part of the Gramene Project (Gramene.org), but has not been actively funded or developed. Some maintenance work on the EO was undertaken as part of the Plant Ontology project, which was funded from 2009-2013 by the National Science Foundation. The EO is now supported under the new Planteome Project, which is supported by National Science Foundation Award #1340112. |
| <b>Plant Ontology</b>                                   | <b>PO</b>  | Laurel Cooper             | cooperl@science.oregonstate.edu | <a href="http://www.plantontology.org/">http://www.plantontology.org/</a>  | Plant Ontology is an international collaborative effort and is supported by primary funding (IOS:0822201 award) from the National Science Foundation of USA.  |

| 1. Name of the ontology or vocabulary    | 2. Alternative name or acronym | 3. Contact person (First) | 4. Contact e-mail               | 5. URL(s) of the ontology or vocabulary   | 6. Who or what organization is supporting the ontology or vocabulary?  |
|--|--------------------------------|---------------------------|---------------------------------|---|--|
| <b>Plant Trait Ontology</b>              | <b>TO</b>                      | Laurel Cooper             | cooperl@science.oregonstate.edu | Dev:<br><a href="http://palea.cgrb.oregonstate.edu/amigo/TO_dev">http://palea.cgrb.oregonstate.edu/amigo/TO_dev</a> ; Live:<br><a href="http://planteome.org">http://planteome.org</a>  | The Plant Trait Ontology was originally started as part of the Gramene Project (Gramene.org), but has not been actively funded or developed until the present time. Some maintenance work on the TO was undertaken as part of the Plant Ontology project, which was funded from 2009-2013 by the National Science Foundation. The TO is now supported under the new Planteome Project, which is supported by National Science Foundation Award #1340112. |
| <b>Population and Community Ontology</b> | <b>PCO</b>                     | Ramona Walls              | rlwalls2008@gmail.com           | <a href="http://purl.obolibrary.org/obo/pco.owl">http://purl.obolibrary.org/obo/pco.owl</a>   | This ontology is in early stages of development and not yet fully funded. Initial development has been supported by the RCN4GSC and an NSF EAGER grant for biodiversity standards.   |
| <b>Protein Ontology</b>                  | <b>PRO</b>                     | Darren Natale             | dan5@georgetown.edu             | <a href="http://proconsortium.org">http://proconsortium.org</a> (main page) // <a href="ftp://ftp.pir.georgetown.edu/databases/ontology/pro_obo/pro.obo">ftp://ftp.pir.georgetown.edu/databases/ontology/pro_obo/pro.obo</a> (main distribution file) | PRO Consortium   |

| 1. Name of the ontology or vocabulary   | 2. Alternative name or acronym        | 3. Contact person (First) | 4. Contact e-mail                | 5. URL(s) of the ontology or vocabulary  | 6. Who or what organization is supporting the ontology or vocabulary?   |
|---|---------------------------------------|---------------------------|----------------------------------|--|---|
| <b>Sequence Ontology</b>  | <b>SO</b>                             | Karen Eilbeck             | keilbeck@genetics.utah.edu       | www.sequenceontology.org   | The SO is currently supported by the NHGRI. We also have a contract with South Alabama University to further develop certain areas. The SO is the underlying ontology used by the genome annotation tool MAKER - which is commonly used by the plant community. |
| <b>Variation Ontology</b>   | <b>VariO</b>                          | Mauno Vihinen             | mauno.vihinen@med.lu.se          | http://variationontology.org   | Lund University   |
| <b>Wheat Ontology INRA</b>  | <b>Wheat_Ontology</b>                 | Jacques Nédellec          | jacques.legouis@clermont.inra.fr | https://urgi.versailles.inra.fr/beta/ephenis/  | INRA Arvalis  |
| <b>Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO)</b> | <b>CO_121 and CO_715</b>              | Rosemary Shrestha         | r.shrestha2@cgiar.org            | http://www.cropontology.org/   | the Integrated Breeding Platform; Bioversity International; CIMMYT; CGIAR   |
| <b>Wheat trait ontology: Embedded in Crop Ontology</b>  | <b>CO_321</b>                         | Rosemary Shrestha         | r.shrestha2@cgiar.org            | http://www.cropontology.org/   | Organization: CIMMYT, IBP and Crop Ontology team. Projects: CRP wheat, IBP  |
| <b>WheatPhenotype</b>   | <b>phenotypes and traits in Wheat</b> | Claire Nédellec           | claire.nedellec@jouy.inra.fr     | http://genome.jouy.inra.fr/bibliome/WheatPhenotypeOntology/WheatPhenotypeOntology-v2.0 | Bibliome team, MaAGE laboratory, INRA (French Institute for Agronomics)   |

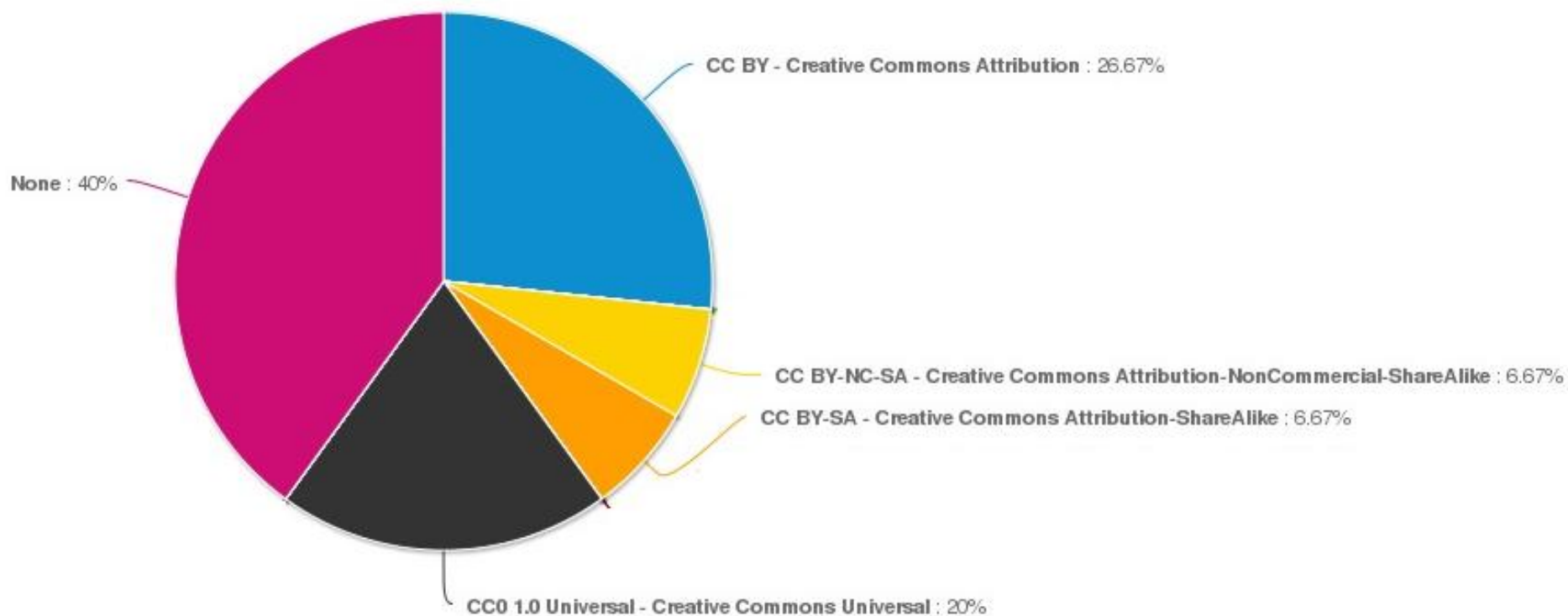
7. Is your ontology or vocabulary regularly maintained and updated



| ontology or vocabulary   | Is it regularly updated? | If yes, do you have a regular release schedule?   |
|--|--------------------------|---|
| Experimental Factor Ontology   | Yes                      | 15th of every month   |
| AGROVOC  | Yes                      | Twice a year, on average  |
| Wheat trait ontology: Embedded in Crop Ontology  | Yes                      | We do not have scheduled dates for its release. The ontology is updated when breeders measure new traits in their trials.   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Yes                      | We release each species-specific ontology when the curator is ready to upload a new version.  |
| Sequence Ontology  | Yes                      | We should release regularly but at the moment the updates are checked into SVN and occasionally rolled into a release.  |
| NAL Thesaurus  | Yes                      | yes, annually on January 1st of every year since 2002   |
| CAB Thesaurus  | Yes                      | Yes, every 12 to 18 months to public. More frequently to customers. Immediate, most up-to-date version is available to collaborators. Updated daily internally within CABI. |
| Protein Ontology   | Yes                      | Yes, roughly monthly  |
| Chemical Entities of Biological Interest   | Yes                      |   |
| Phenotype And Trait Ontology   | Yes                      |   |
| Wheat Ontology INRA  | Yes                      |   |
| Feature Annotation Location Description Ontology   | Yes                      | no  |
| Variation Ontology   | Yes                      | No  |
| WheatPhenotype   | Yes                      | no  |
| Environment Ontology   | Yes                      | No - we make new releases reactively, after a round of changes.   |
| Cell Ontology  | Yes                      | No, the release schedule varies according to the degree of activity in editing the ontology.  |
| Crop Ontology  | Yes                      | No. It is on-demand. We release each species-specific ontology when the curator is ready to upload a new version.   |
| Plant Ontology   | Yes                      | Not Currently   |
| Plant Experimental Conditions Ontology   | No                       |   |
| Plant Trait Ontology   | No                       |   |
| Population and Community Ontology  | No                       |   |



## 8. What License and/or Copyright is used?



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Research Data Alliance (RDA)

February 2015



| ontology or vocabulary   | Type of License  |
|--|--|
| Feature Annotation Location Description Ontology   | CC0 1.0 Universal - Creative Commons Universal   |
| Chemical Entities of Biological Interest   | CC BY - Creative Commons Attribution   |
| Plant Ontology   | CC BY - Creative Commons Attribution   |
| Plant Experimental Conditions Ontology   | CC BY - Creative Commons Attribution   |
| Protein Ontology   | CC BY - Creative Commons Attribution   |
| Cell Ontology  | CC BY 3.0  |
| AGROVOC  | CC BY 3.0  |
| Plant Trait Ontology   | CC BY-NC-SA - Creative Commons Attribution-NonCommercial-ShareAlike  |
| WheatPhenotype   | CC BY-SA - Creative Commons Attribution-ShareAlike   |
| Population and Community Ontology  | CC0 1.0 Universal - Creative Commons Universal   |
| NAL Thesaurus  | CC0 1.0 Universal - Creative Commons Universal   |
| Phenotype And Trait Ontology   | 3-clause BSD license   |
| Experimental Factor Ontology   | EMBL-EBI License <a href="http://www.ebi.ac.uk/about/terms-of-use">http://www.ebi.ac.uk/about/terms-of-use</a> |
| Environment Ontology   | New BSD  |
| CAB Thesaurus  | Copyright - all rights reserved  |
| Sequence Ontology  | None   |
| Variation Ontology   | None   |
| Wheat trait ontology: Embedded in Crop Ontology  | None   |
| Crop Ontology  | None   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | None   |
| Wheat Ontology INRA  | None   |

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| ontology or vocabulary   | 9. Please list any relevant publications about the ontology or vocabulary:   |
|--|--|
| Crop Ontology  | <p>(ii) Arnaud E. et. al., (2012). Towards a Reference Plant Trait Ontology for Modeling Knowledge of Plant Traits and Phenotypes. In Proceedings of the International Conference on Knowledge Engineering and Ontology Development, pages220-225, SciTePress. DOI: 10.5220/0004138302200225</p> <p>(iii) Shrestha R. et. al., (2012) Bridging the phenotypic and genetic data useful for integrated breeding through a data annotation using the Crop Ontology developed by the crop communities of practice. <i>Frontiers in Plant Physiology</i> v. 3 Article 326: doi: 10.3389/fphys.2012.00326 , ISSN: 1664-042X</p> <p>(iv) Shrestha, R. et al., (2010). Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature. <i>AoB Plants</i> (2010) Vol. 2010 first published online May 27, 2010 doi:10.1093/aobpla/plq008 (<a href="http://aobpla.oxfordjournals.org/content/2010/plq008.abstract">http://aobpla.oxfordjournals.org/content/2010/plq008.abstract</a>).</p> |
| Plant Trait Ontology   | <p>* Arnaud E, Cooper L, Shrestha R, Menda N, Nelson RT, Matteis L, Skofic M, Bastow R, Jaiswal P, Mueller L, et al (2012) Towards a reference Plant Trait Ontology for modeling knowledge of plant traits and phenotypes. <i>Proceedings of the International Conference on Knowledge Engineering and Ontology Development</i>. Barcelona, Spain, pp 220-225</p> <p>* Jaiswal P, Ware D, Ni J, Chang K, Zhao W, Schmidt S, Pan X, Clark K, Teytelman L, Cartinhour S, et al (2002) Gramene: development and integration of trait and gene ontologies for rice. <i>Comparative and Functional Genomics</i> 3: 132-136</p>  |
| Phenotype And Trait Ontology   | <ol style="list-style-type: none"> <li>1. G. V. Gkoutos, E. Green, A-M Mallon, J.M. Hancock and D. Davidson, Using ontologies to describe mouse phenotypes. <i>Genome Biology</i>, 2005, 6, R8.</li> <li>2. G. V. Gkoutos, E. C. J. Green, J.M. Hancock, D. Davidson, Building Mouse Phenotype Ontologies, <i>Pac Symp Biocomput</i>, 2004, 9, 179-189.</li> <li>3. G. V. Gkoutos, C. Mungall, S. Dolken, M. Ashburner, S. Lewis, J. Hancock, P. Schofield, S Kohler and P. Robinson, Entity-Quality-Based Logical Definitions for the Human Skeletal Phenome using PATO, <i>Conf Proc IEEE Eng Med Biol Soc</i>. 2009;1:7069-72.</li> <li>4. C. Mungall, G. V. Gkoutos, C. Smith, M. Haendel, S. Lewis, M. Ashburner, Integrating phenotype ontologies across multiple species, <i>Genome Biol.</i>, 2010, Jan 8;11(1):R2. There are several other papers directly involving PATO.</li> </ol>   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | <p>2012 - Shrestha Rosemary, Matteis Luca, Skofic Milko, Portugal Arlett, McLaren Graham, Hyman Glenn, Arnaud Elizabeth - Bridging the phenotypic and genetic data useful for integrated breeding through a data annotation using the Crop Ontology developed by the crop communities of practice , in <i>Frontiers in Physiology</i> , vol.3, no.0326<br/> URL=<a href="http://www.frontiersin.org/Journal/Abstract.aspx?s=907&amp;name=plant_physiology&amp;ART_DOI=10.3389/fphys.2012.00326">http://www.frontiersin.org/Journal/Abstract.aspx?s=907&amp;name=plant_physiology&amp;ART_DOI=10.3389/fphys.2012.00326</a></p> <p>2012 - Elizabeth Arnaud, Laurel Cooper, Rosemary Shrestha, Naama Menda, Rex T. Nelson, Luca Matteis, Milko Skofic, Ruth Bastow, Pankaj Jaiswal, Lukas Mueller, Graham McLaren: Towards a Reference Plant Trait Ontology For Modeling Knowledge of Plant Traits and Phenotypes in: <i>proceedings of the 4th Conference on Knowledge Engineering and Ontology Development</i>, 4-7</p>                                     |

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|----------------------|--|
|                      | <p>October 2012 , Spain.</p> <p>2010 - Rosemary Shrestha, Elizabeth Arnaud, Ramil Mauleon, Martin Senger, Guy F. Davenport, David Hancock, Norman Morrison, Richard Bruskiwich, and Graham McLaren - Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature, AoB PLANTS (2010) Vol. 2010 first published online May 27, 2010 doi:10.1093/aobpla/plq008 - <a href="http://aobpla.oxfordjournals.org/citmgr?gca=aobpla;2010/0/plq008">http://aobpla.oxfordjournals.org/citmgr?gca=aobpla;2010/0/plq008</a></p>   |
| Sequence Ontology    | <p>A standard variation file format for human genome sequences Reese MG, Moore B, Batchelor C, Salas F, Cunningham F, Marth GT, Stein L, Flicek P, Yandell M, Eilbeck K Genome Biology 2010, 11:R88 SOBA: sequence ontology bioinformatics analysis Moore B, Fan G, Eilbeck K Nucl Acids Res 2010, 38(suppl 2)</p> <p>Evolution of the Sequence Ontology terms and relationships Mungall, C. J. Batchelor C. Eilbeck K. J Biomed Inform. 2010 Mar 10</p> <p>Quantitative Measures for the Management and Comparison of Annotated Genomes. Eilbeck K., Moore B., Holt C., Yandell M. BMC Bioinformatics 2009, 10:67</p> <p>The Sequence Ontology: A tool for the unification of genome annotations. Eilbeck K., Lewis S., Mungall C.J., Yandell M., Stein L., Durbin R., Ashburner M. Genome Biology (2005) 6:R44</p>   |
| Environment Ontology | <p>Buttigieg PL, Morrison N, Smith B, Mungall CJ, Lewis SE, and the ENVO Consortium (2013) The environment ontology: contextualising biological and biomedical entities. J Biomed Semant. 4:43.</p> <p>Walls, R. L., Deck, J., Guralnick, R., Baskauf, S., Beaman, R., Blum, S., ... &amp; Wooley, J. (2014). Semantics in Support of Biodiversity Knowledge Discovery: An Introduction to the Biological Collections Ontology and Related Ontologies. PloS one, 9(3), e89606.</p> <p>Walls, R. L., Guralnick, R., Deck, J., Buntzman, A., Buttigieg, P. L., Davies, N., ... &amp; Zheng, J. (2014). Meeting report: advancing practical applications of biodiversity ontologies. Standards in Genomic Sciences, 9(1), 17.</p> <p>Pafilis, E., Frankild, S. P., Schnetzer, J., Fanini, L., Faulwetter, S., Pavloudi, C., ... &amp; Jensen, L. J. (2014). ENVIRONMENTS and EOL: identification of Environment Ontology terms in text and the annotation of the Encyclopedia of Life. bioRxiv, 011403.</p> |
| WheatPhenotype       | <p>Claire Nédellec, Robert Bossy, Dialekti Valsamou, Marion Ranoux, Wiktoria Golik, Pierre Sourdille. Information Extraction from Bibliography for Marker Assisted Selection in Wheat. In proceedings of Metadata and Semantics for Agriculture, Food &amp; Environment (AgroSEM'14), special track of the 8th Metadata and Semantics Research Conference (MTR'14), Karlsruhe, Germany, 2014. DOI: 10.1007/978-3-319-13674-5_28</p>  |

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|  |   |
|--|---|
| Plant Ontology                           | <p>Cooper L, Walls RL, Elser J, Gandolfo MA, Stevenson DW, Smith B, Preece J, Athreya B, Mungall CJ, Rensing S et al.. 2013. The Plant Ontology as a Tool for Comparative Plant Anatomy and Genomic Analyses. <i>Plant &amp; Cell Physiology</i>. 54(2):1-23</p> <p>Lens F, Cooper L, Gandolfo MA, Groover P, Jaiswal P, Lachenbruch R, Spicer R, Staton D, Stevenson DW, Walls RL et al.. 2012. An extension of the Plant Ontology project supporting wood anatomy and development research. <i>IAWA Journal</i>. 33:113-117</p> <p>Walls RL, Athreya B, Cooper L, Elser J, Gandolfo MA, Jaiswal P, Mungall CJ, Preece J, Rensing S, Smith B et al.. 2012. Ontologies as Integrative Tools for Plant Science. <i>American Journal of Botany</i>. 99(8):1263-75.</p> <p>Pujar A, Jaiswal P, Kellogg EA, Ilic K, Vincent L, Avraham S, Stevens P, Zapata F, Reiser L, Rhee SY et al.. 2006. Whole-plant growth stage ontology for angiosperms and its application in plant biology. <i>Plant Physiology</i>. 142(2):414-28</p> <p>Jaiswal P, Avraham S, Ilic K, Kellogg EA, McCouch S, Pujar A, Reiser L, Rhee SY, Sachs MM, Schaeffer M et al.. 2005. Plant Ontology (PO): a Controlled Vocabulary of Plant Structures and Growth Stages.</p> |
| Chemical Entities of Biological Interest | <p>Hastings, J., de Matos, P., Dekker, A., Ennis, M., Harsha, B., Kale, N., Muthukrishnan, V., Owen, G., Turner, S., Williams, M., and Steinbeck, C. (2013) The ChEBI reference database and ontology for biologically relevant chemistry: enhancements for 2013. <i>Nucleic Acids Res</i>. 41 (D1): D456 - D463.</p> <p>de Matos, P., Alcantara, R., Dekker, A., Ennis, M., Hastings, J., Haug, K., Spiteri, I., Turner, S., and Steinbeck, C. (2010) Chemical entities of biological interest: an update. <i>Nucleic Acids Res</i>. 38 (suppl 1): D249-D254.</p> <p>Degtyarenko, K., Hastings, J., de Matos, P., and Ennis, M. (2009). ChEBI: an open bioinformatics and cheminformatics resource. <i>Current protocols in bioinformatics / editorial board, Andreas D. Baxevanis ... [et al.], Chapter 14</i>. Degtyarenko, K., de Matos, P., Ennis, M., Hastings, J., Zbinden, M., McNaught, A., Alcántara, R., Darsow, M., Guedj, M. and Ashburner, M. (2008) ChEBI: a database and ontology for chemical entities of biological interest. <i>Nucleic Acids Res</i>. 36, D344-D350.</p>  |
| Population and Community Ontology        | <p><a href="http://www.ncbi.nlm.nih.gov/pubmed/24595056">http://www.ncbi.nlm.nih.gov/pubmed/24595056</a> <a href="http://www.standardsingenomics.com/content/9/1/17/abstract">http://www.standardsingenomics.com/content/9/1/17/abstract</a></p>  |
| Experimental Factor Ontology             | <p>James Malone, Ele Holloway, Tomasz Adamusiak, Misha Kapushesky, Jie Zheng, Nikolay Kolesnikov, Anna Zhukova, Alvis Brazma, Helen Parkinson (2010) Modeling sample variables with an Experimental Factor Ontology, <i>Bioinformatics</i>, 26(8), p. 1112-1118</p>   |
| Cell Ontology                            | <p>Logical development of the cell ontology (<a href="http://www.ncbi.nlm.nih.gov/pubmed/21208450">http://www.ncbi.nlm.nih.gov/pubmed/21208450</a>) An improved ontological representation of dendritic cells as a paradigm for all cell types (<a href="http://www.ncbi.nlm.nih.gov/pubmed/19243617">http://www.ncbi.nlm.nih.gov/pubmed/19243617</a>) An ontology for cell types (<a href="http://www.ncbi.nlm.nih.gov/pubmed/15693950">http://www.ncbi.nlm.nih.gov/pubmed/15693950</a>)</p>   |
| CAB Thesaurus                            | <p>Please see <a href="http://www.cabi.org/cabthesaurus/">http://www.cabi.org/cabthesaurus/</a> for information on coverage, etc.</p>   |
| Protein Ontology                         | <p>See list under 'Publications' at <a href="http://pir.georgetown.edu/pro/pro_dsmnt.shtml#publication">http://pir.georgetown.edu/pro/pro_dsmnt.shtml#publication</a></p>   |
| AGROVOC                                  | <p>See: <a href="http://aims.fao.org/standards/agrovoc/publications">http://aims.fao.org/standards/agrovoc/publications</a></p>   |

**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

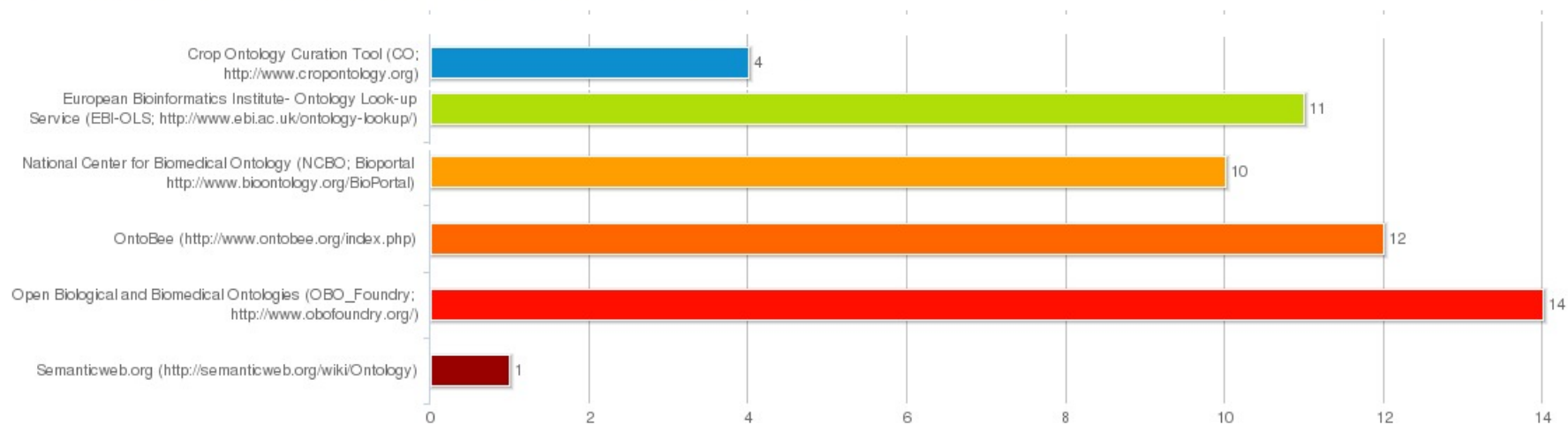
Research Data Alliance (RDA)

February 2015



|  |  |
|--|--|
| Wheat trait ontology: Embedded in Crop Ontology  | <p>Shrestha Rosemary, Matteis Luca, Skofic Milko, Portugal Arlett, McLaren Graham, Hyman Glenn, Arnaud Elizabeth. 2012. Bridging the phenotypic and genetic data useful for integrated breeding through a data annotation using the Crop Ontology developed by the crop communities of practice. In: <i>Frontiers in Physiology</i>, vol.3, no.0326<br/>                 URL=<a href="http://www.frontiersin.org/Journal/Abstract.aspx?s=907&amp;name=plant_physiology&amp;ART_Doi=10.3389/fphys.2012.00326">http://www.frontiersin.org/Journal/Abstract.aspx?s=907&amp;name=plant_physiology&amp;ART_Doi=10.3389/fphys.2012.00326</a><br/>                 Elizabeth Arnaud, Laurel Cooper, Rosemary Shrestha, Naama Menda, Rex T. Nelson, Luca Matteis, Milko Skofic, Ruth Bastow, Pankaj Jaiswal, Lukas Mueller, Graham McLaren. 2012. Towards a Reference Plant Trait Ontology For Modeling Knowledge of Plant Traits and Phenotypes. In: <i>proceedings of the 4th Conference on Knowledge Engineering and Ontology Development</i>, 4-7 October 2012, Spain.</p> <p>Rosemary Shrestha, Elizabeth Arnaud, Ramil Mauleon, Martin Senger, Guy F. Davenport, David Hancock, Norman Morrison, Richard Bruskiwich, and Graham McLaren. 2010. Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature, <i>AoB PLANTS</i> (2010) Vol. 2010 first published online May 27, 2010<br/>                 doi:10.1093/aobpla/plq008 - <a href="http://aobpla.oxfordjournals.org/citmgr?gca=aobpla;2010/0/plq008">http://aobpla.oxfordjournals.org/citmgr?gca=aobpla;2010/0/plq008</a></p> |
| Variation Ontology                               | <p>Vihinen, M., 2014. Variation Ontology for annotation of variation effects and mechanisms. <i>Genome Res.</i> 24(2): 356-364<br/>                 Vihinen, M., 2014. Variation ontology: annotator guide. <i>J Biomed Semantics</i> 5(1): 9</p>  |
| Plant Experimental Conditions Ontology           | none   |
| Feature Annotation Location Description Ontology |  |
| NAL Thesaurus                                    |  |
| Wheat Ontology INRA                              |  |

10. Is the ontology or vocabulary part of any ontology communities or listing services?



**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

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| ontology or vocabulary   | 10. Is the ontology or vocabulary part of any ontology communities or listing services?   |
|--|---|
| Environment Ontology   | Crop Ontology Curation Tool (CO; <a href="http://www.croponontology.org">http://www.croponontology.org</a> ) European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> ) National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> ) OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> ) |
| Crop Ontology  | Crop Ontology Curation Tool (CO; <a href="http://www.croponontology.org">http://www.croponontology.org</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> ) FAO -AIMES   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Crop Ontology Curation Tool (CO; <a href="http://www.croponontology.org">http://www.croponontology.org</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )  |
| Wheat trait ontology: Embedded in Crop Ontology  | Crop Ontology Curation Tool (CO; <a href="http://www.croponontology.org">http://www.croponontology.org</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )  |
| Cell Ontology  | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> ) National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> ) OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> ) Semanticweb.org ( <a href="http://semanticweb.org/wiki/Ontology">http://semanticweb.org/wiki/Ontology</a> )  |
| Chemical Entities of Biological Interest   | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> ) National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> ) OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )  |
| Experimental Factor Ontology   | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> ) National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> ) OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )  |
| Phenotype And Trait Ontology   | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> ) National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> ) OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> ) Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )  |



## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

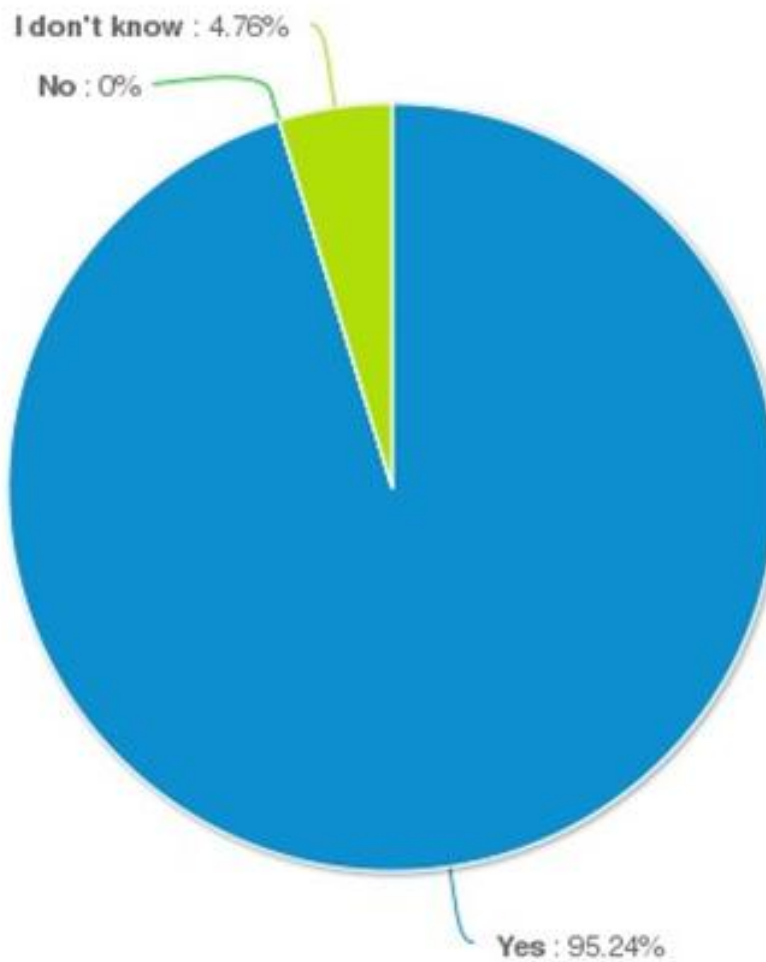
Research Data Alliance (RDA)

February 2015



|  |  |
|--|--|
| Plant Experimental Conditions Ontology           | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )<br>planteome.org |
| Plant Ontology                                   | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )                  |
| Plant Trait Ontology                             | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )<br>planteome.org |
| Protein Ontology                                 | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )                  |
| Sequence Ontology                                | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>National Center for Biomedical Ontology (NCBO; Bioportal <a href="http://www.bioontology.org/BioPortal">http://www.bioontology.org/BioPortal</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )                  |
| Variation Ontology                               | European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <a href="http://www.ebi.ac.uk/ontology-lookup/">http://www.ebi.ac.uk/ontology-lookup/</a> )<br>OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )  |
| CAB Thesaurus                                    | Global Agricultural Concept Scheme (GACS)  |
| AGROVOC  | <a href="http://datahub.io/">http://datahub.io/</a>  |
| Wheat Ontology INRA                              | <a href="https://urgi.versailles.inra.fr/beta/epheis">https://urgi.versailles.inra.fr/beta/epheis</a>  |
| WheatPhenotype                                   | Inra (Avoca, <a href="https://wiki.inra.fr/wiki/avoca/Vocabulaires/">https://wiki.inra.fr/wiki/avoca/Vocabulaires/</a> )   |
| Population and Community Ontology                | OntoBee ( <a href="http://www.ontobee.org/index.php">http://www.ontobee.org/index.php</a> )<br>Open Biological and Biomedical Ontologies (OBO_Foundry; <a href="http://www.obofoundry.org/">http://www.obofoundry.org/</a> )   |
| Feature Annotation Location Description Ontology | None   |
| NAL Thesaurus                                    | none   |

### 11. Is your ontology or vocabulary used or implemented in any database/repository?



## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

Research Data Alliance (RDA)

February 2015



| ontology or vocabulary                           | 11. Is it used or implemented in any database/repository? | If yes, please list them:   |
|--|---|---|
| AGROVOC  | Yes   | whole list: <a href="http://aims.fao.org/standards/agrovoc/uses-agrovoc">http://aims.fao.org/standards/agrovoc/uses-agrovoc</a>   |
| CAB Thesaurus                                    | Yes   | Used in CAB Abstracts database available on the following platforms: - CAB Direct (CABI's own platform) - Dialog - Dimdi - EBSCO - OvidSP - STN International - Thomson Web of Knowledge Used in many other CABI databases, including Plantwise ( <a href="http://www.plantwise.org/">http://www.plantwise.org/</a> ), various CABI Compendia products (Crop Protection Compendium; Animal Health and Protection Compendium; Aquaculture Compendium; Forestry Compendium), and forms the basis of all CABI information products.                  |
| Cell Ontology                                    | Yes   | <a href="http://amigo.geneontology.org/amigo">http://amigo.geneontology.org/amigo</a> , <a href="http://www.cellimagelibrary.org">http://www.cellimagelibrary.org</a> , <a href="https://import.niaid.nih.gov/">https://import.niaid.nih.gov/</a> , <a href="http://www.import-labs.org/import-immunexpresso/">http://www.import-labs.org/import-immunexpresso/</a> , and others  |
| Chemical Entities of Biological Interest         | Yes   | UniProt Rhea Reactome Biomodels PubChem IntAct IEDB ArrayExpress HMDB DrugBank  |
| Crop Ontology                                    | Yes   | Breeding Management System of the Integrated Breeding Platform (IBP, <a href="https://www.integratedbreeding.net/">https://www.integratedbreeding.net/</a> ) Global Agricultural Trials Repository (Agtrials; <a href="http://www.agtrials.org">www.agtrials.org</a> ) Cassabase, ( <a href="http://www.cassavabase.org/">http://www.cassavabase.org/</a> ) EU-SOL BreedDB(Wageningen, <a href="https://www.eu-sol.wur.nl/">https://www.eu-sol.wur.nl/</a> ) Phenomics Ontology Driven Data repository(PODD, Australian Plant Phenomics Facility) |
| Environment Ontology                             | Yes   |   |
| Experimental Factor Ontology                     | Yes   | ArrayExpress, Expression Atlas at EBI, Ensembl, UniProt, European Variation Archive, Cell Finder, Pride protein database, Reactome, ENCODE cell line database, Centre for Therapeutic Target Validation, Rikenbase  |
| Feature Annotation Location Description Ontology | Yes   | uniprot ddbj pdb ensembl biointerchange   |
| NAL Thesaurus                                    | Yes   | AGRICOLA  |
| Phenotype And Trait Ontology                     | Yes   | several databases utilise PATO based annotations  |
| Plant Experimental Conditions Ontology           | Yes   | planteome.org, Gramene  |

## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

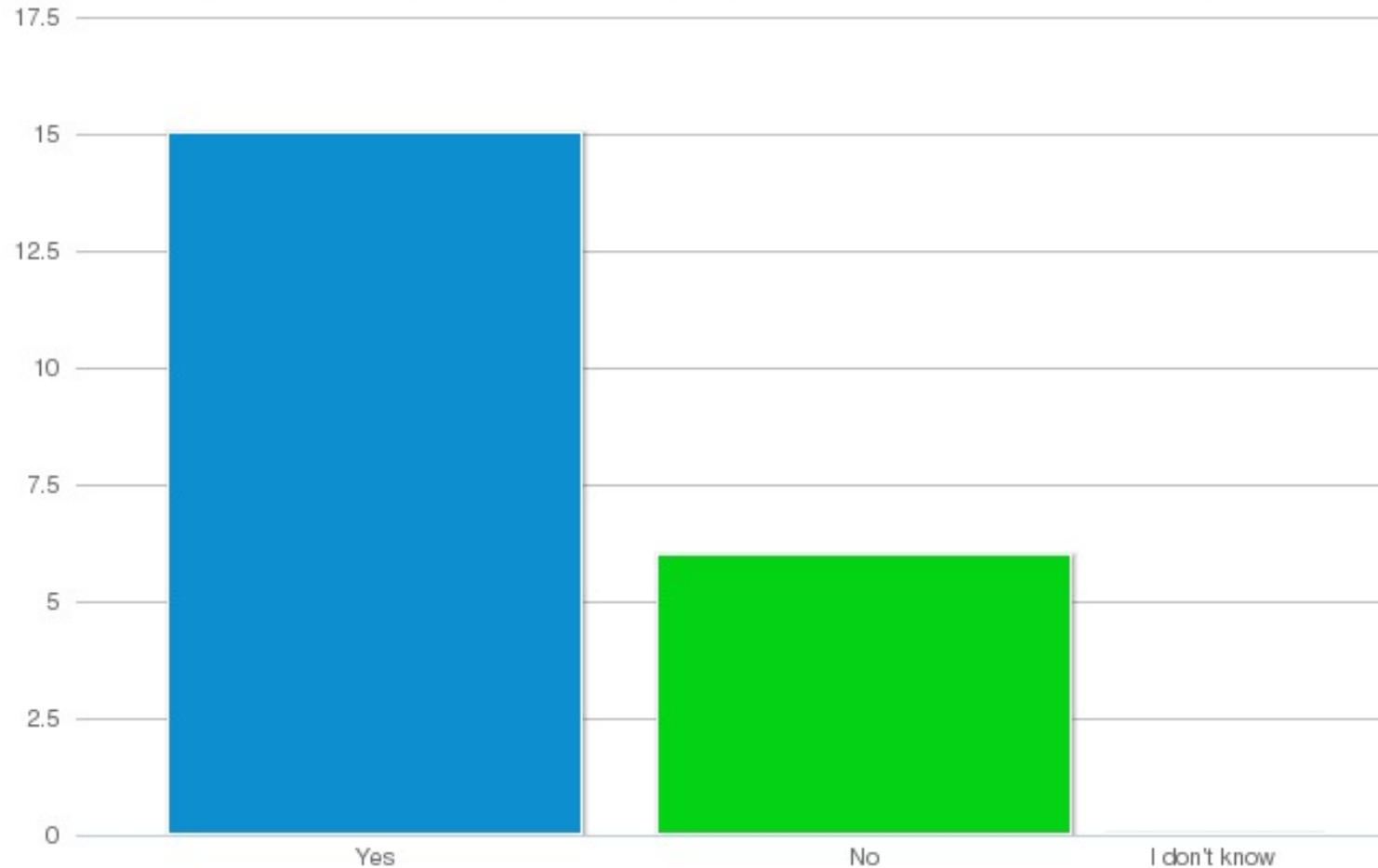
Research Data Alliance (RDA)

February 2015

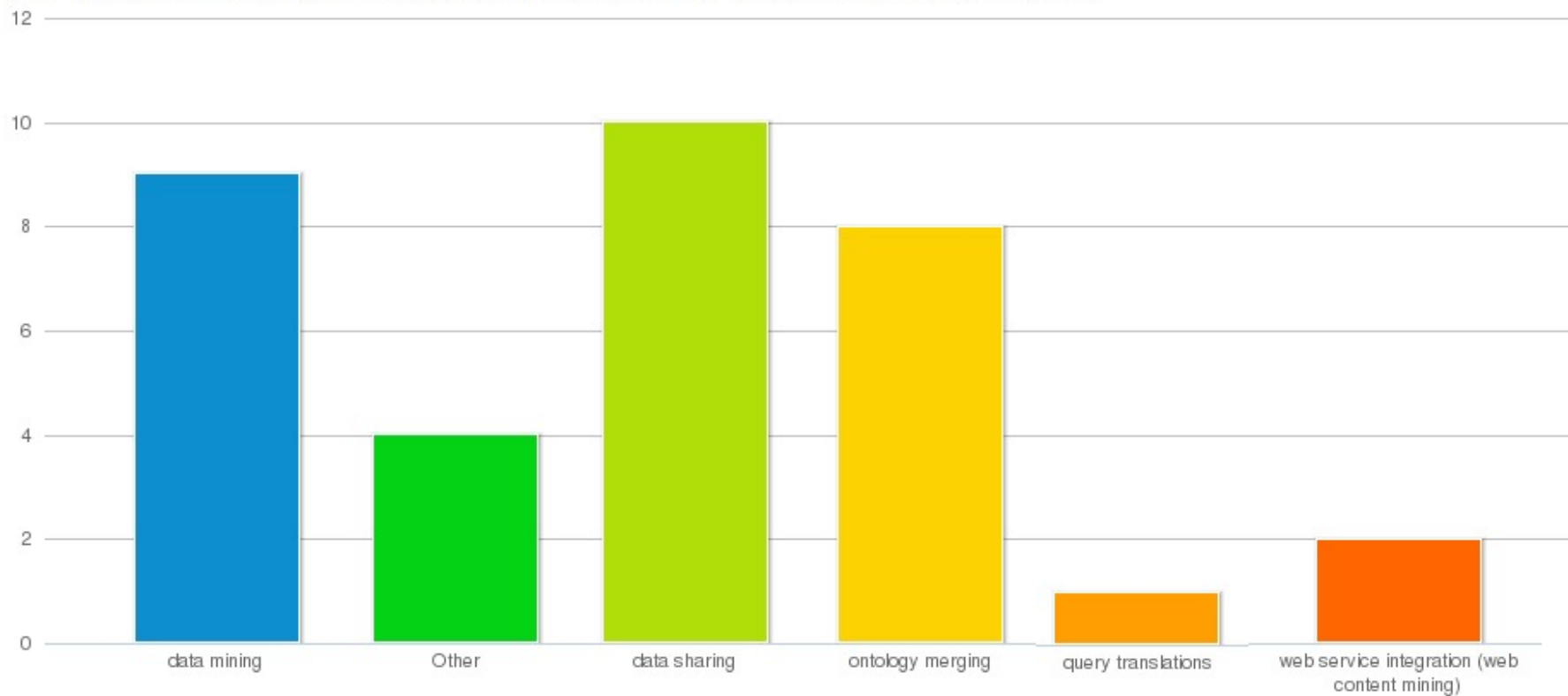


|  |              |   |
|--|--------------|---|
| Plant Ontology   | Yes          | We have our own in-house database at: <a href="http://www.plantontology.org">http://www.plantontology.org</a> , plus our new platform <a href="http://www.planteome.org">http://www.planteome.org</a> . The Plant Ontology is integrated in many other databases and platforms, here is an incomplete list: <a href="http://www.gramene.org/">http://www.gramene.org/</a> <a href="https://www.araport.org/">https://www.araport.org/</a> <a href="http://www.arabidopsis.org/">http://www.arabidopsis.org/</a> <a href="http://www.maizegdb.org/">http://www.maizegdb.org/</a> <a href="http://soybase.org/">http://soybase.org/</a> <a href="http://solgenomics.net/">http://solgenomics.net/</a> <a href="http://www.cosmoss.org/">http://www.cosmoss.org/</a> <a href="http://floranorthamerica.org/">http://floranorthamerica.org/</a> <a href="http://geneontology.org/">http://geneontology.org/</a> <a href="http://www.iplantcollaborative.org/">http://www.iplantcollaborative.org/</a> <a href="http://www.shigen.nig.ac.jp/plantontology/ja/go.cgi">http://www.shigen.nig.ac.jp/plantontology/ja/go.cgi</a> <a href="http://arabidopsis.info/bioinformatics/Ontology_details.html">http://arabidopsis.info/bioinformatics/Ontology_details.html</a> <a href="http://www.plexdb.org/">http://www.plexdb.org/</a> <a href="http://www.shigen.nig.ac.jp/rice/oryzabase/">http://www.shigen.nig.ac.jp/rice/oryzabase/</a> |
| Plant Trait Ontology   | Yes          | <a href="http://planteome.org">planteome.org</a> , <a href="http://Gramene.org">Gramene</a> , <a href="http://SoyBase.org">SoyBase</a> , <a href="http://maizeGDB.org">maizeGDB</a> , <a href="http://TriticeaeToolbox.org">Triticeae toolbox</a> ( <a href="http://triticeaetoolbox.org/wheat/traits.php">http://triticeaetoolbox.org/wheat/traits.php</a> ), <a href="http://OryzaTagLine.org">OryzaTagLine database</a> ( <a href="http://oryzatagline.cirad.fr/cgi-bin/ontology.pl">http://oryzatagline.cirad.fr/cgi-bin/ontology.pl</a> ), <a href="https://ondex.rothamsted.ac.uk/QLNetMiner/">https://ondex.rothamsted.ac.uk/QLNetMiner/</a>   |
| Protein Ontology   | Yes          | <a href="http://GOA.org">GOA</a> , <a href="http://UniProtKB.org">UniProtKB</a>   |
| Sequence Ontology  | Yes          | It is used in GMOD databases. It is used by the EBI variation group, the NCBI databases such as ClinVar use SO terms.   |
| Variation Ontology   | Yes          | <a href="http://structure.bmc.lu.se/VariSNP/index.php">http://structure.bmc.lu.se/VariSNP/index.php</a>   |
| Wheat Ontology INRA  | Yes          | <a href="https://urgi.versailles.inra.fr/gnpis/">https://urgi.versailles.inra.fr/gnpis/</a> <a href="https://urgi.versailles.inra.fr/epheis">https://urgi.versailles.inra.fr/epheis</a>   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Yes          | Breeding Management System of the Integrated Breeding Platform (IBP, <a href="https://www.integratedbreeding.net/">https://www.integratedbreeding.net/</a> ) Global Agricultural Trials Repository (Agtrials; <a href="http://www.agtrials.org">www.agtrials.org</a> )  |
| Wheat trait ontology: Embedded in Crop Ontology  | Yes          | The wheat trait ontology is implemented in the Breeding Management System (BMS) developed by Integrated Breeding Platform (IBP). The traits are generally taken from existing International Wheat Information System (IWIS), CIMMYT.  |
| WheatPhenotype   | Yes          | FSOV Selection Assisted by Markers (SAM) annotations database : <a href="http://genome.jouy.inra.fr/~rbossy/cgi-bin/FSOV/SAM.cgi">http://genome.jouy.inra.fr/~rbossy/cgi-bin/FSOV/SAM.cgi</a> AlvisIR semantic search engine for wheat genetic markers : <a href="http://bibliome.jouy.inra.fr/test/alvisir/FSOV/">http://bibliome.jouy.inra.fr/test/alvisir/FSOV/</a>  |
| Population and Community Ontology  | I don't know |   |

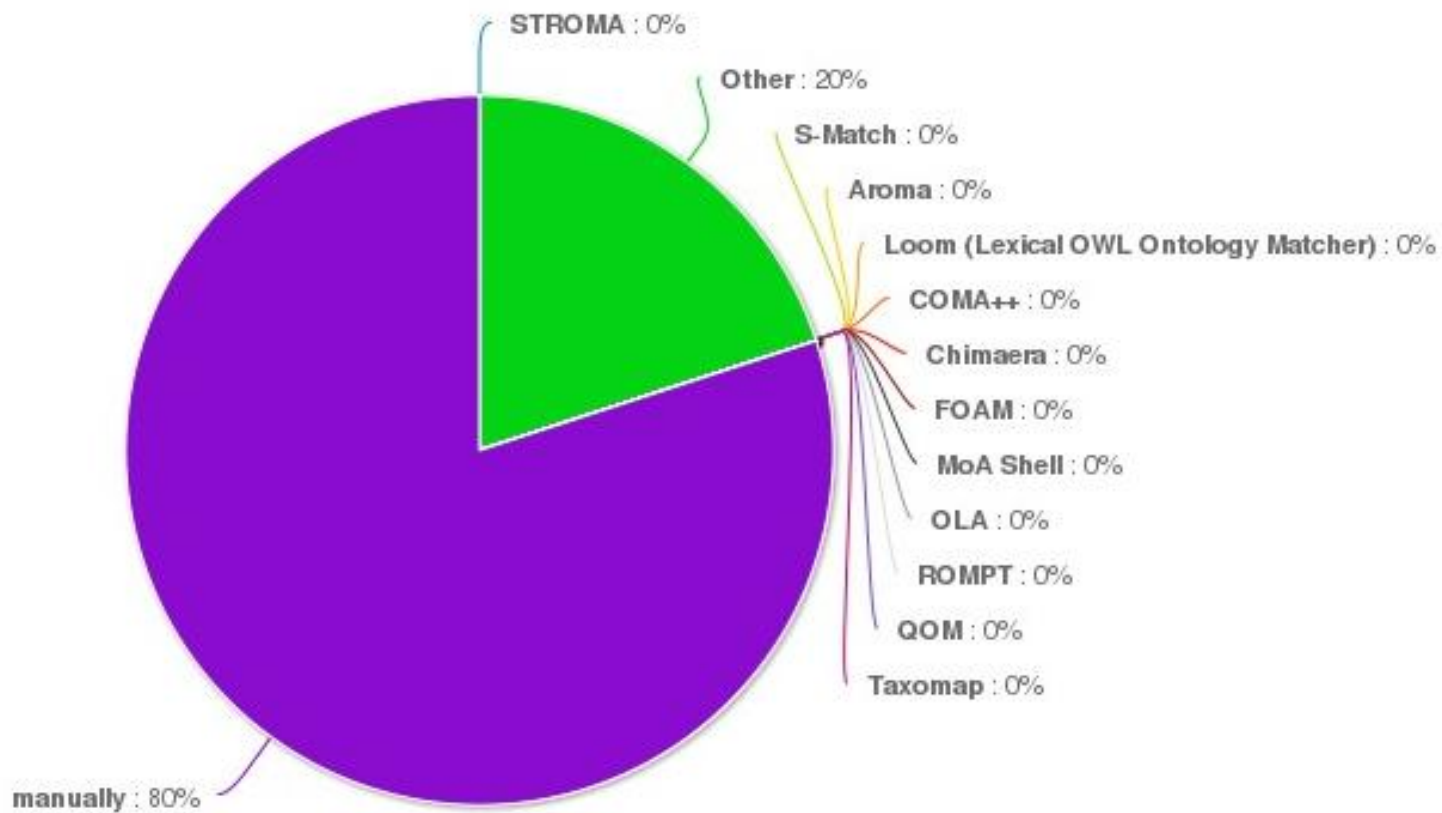
12. Do you interlink and/or map to other ontologies or vocabularies (extends, maps, etc.)



12a. What is the main purpose of mapping your ontology or vocabulary to other resources?



12b. What mapping tools have you used? Please mention the name of the tool



| ontology or vocabulary   | 12. Do you interlink and/or map to other ontologies or vocabularies | 12a. What is the main purpose of mapping your ontology or vocabulary to other resources? | 12b. What mapping tools have you used? Please mention the name of the tool |
|--|---|--|--|
| Crop Ontology  | Yes   | data mining<br>ontology merging  | manually   |
| Phenotype And Trait Ontology   | Yes   | data mining<br>data sharing<br>ontology merging  | manually   |
| Plant Experimental Conditions Ontology   | Yes   | data mining<br>data sharing<br>ontology merging  | manually   |
| Plant Ontology   | Yes   | data mining<br>data sharing  | manually   |
| Plant Trait Ontology   | Yes   | data mining<br>data sharing<br>ontology merging  | manually   |
| Population and Community Ontology  | Yes   | data mining<br>data sharing<br>ontology merging  | manually   |
| Wheat Ontology INRA  | Yes   | data mining<br>data sharing<br>query translations  | manually   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Yes   | data mining<br>ontology merging  | manually   |
| Wheat trait ontology: Embedded in Crop Ontology  | Yes   | data mining<br>data sharing<br>web service integration (web content mining)              | manually   |
| AGROVOC  | Yes   | data sharing<br>web service integration (web content mining)<br>Other: data mashup       | manually<br>Other: Alignment API   |



**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

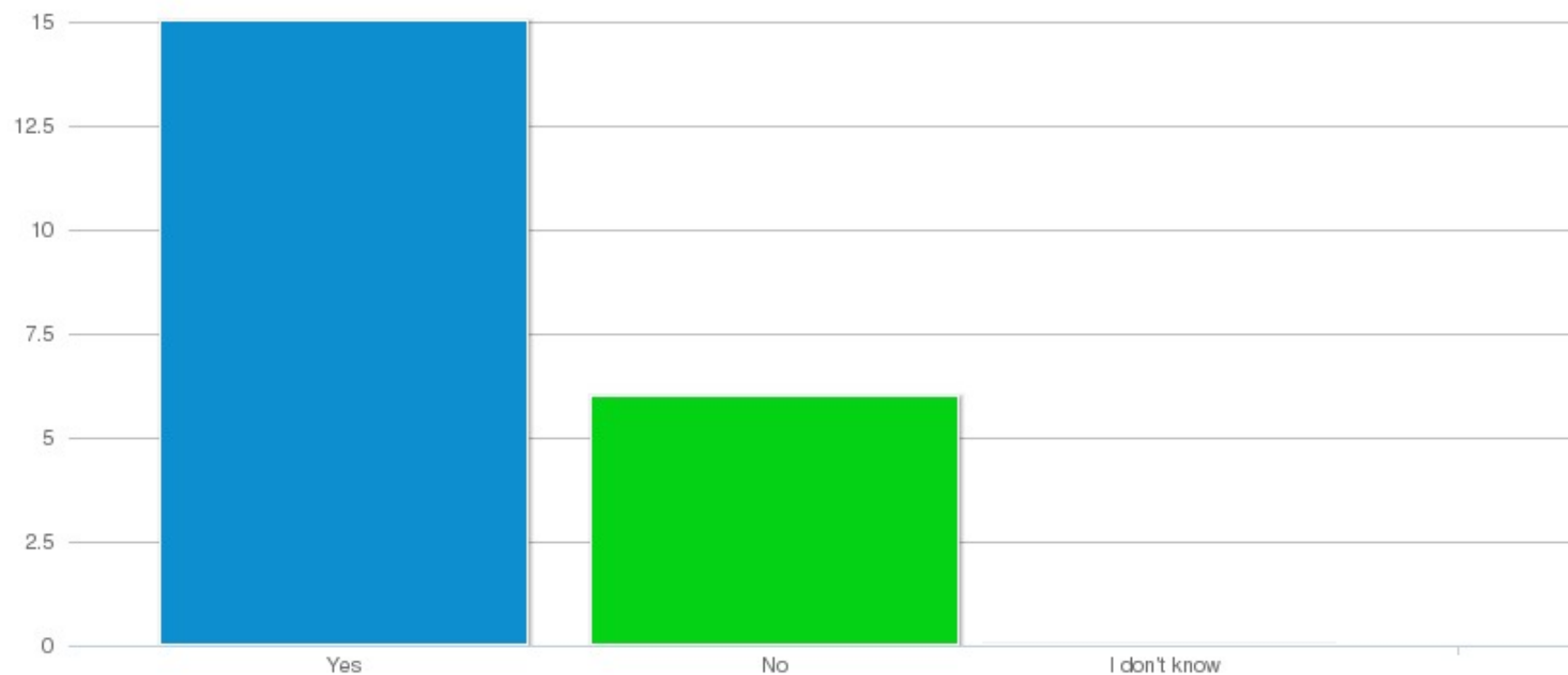
Research Data Alliance (RDA)

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|  |     |  |   |
|--|-----|--|---|
| CAB Thesaurus                                    | Yes | data sharing   | manually<br>Other: Initial automatic matching. Don't know what tool was used. |
| Cell Ontology                                    | Yes | data sharing<br>ontology merging   | manually  |
| Experimental Factor Ontology                     | Yes | ontology merging<br>Other: Integrating data annotated to EFO with other ontologies |   |
| Chemical Entities of Biological Interest         | Yes | Other: Data integration  | manually  |
| Environment Ontology                             | Yes | Other: interoperability  |   |
| Feature Annotation Location Description Ontology | No  |  |   |
| NAL Thesaurus                                    | No  |  |   |
| Protein Ontology                                 | No  |  |   |
| Sequence Ontology                                | No  |  |   |
| Variation Ontology                               | No  |  |   |
| WheatPhenotype                                   | No  |  |   |

13. Does the ontology/vocabulary have a term or issue tracker, such as those on SourceForge or GoogleCode?



| ontology or vocabulary                           | 13. Does the ontology/vocabulary have a term or issue tracker, such as those on SourceForge or GoogleCode? | If so, please provide URL.  |
|--|--|---|
| AGROVOC  | Yes  | for internal use  |
| Cell Ontology                                    | Yes  | <a href="https://code.google.com/p/cell-ontology/issues/list">https://code.google.com/p/cell-ontology/issues/list</a>   |
| Chemical Entities of Biological Interest         | Yes  | <a href="http://sourceforge.net/p/chebi/curator-requests/">http://sourceforge.net/p/chebi/curator-requests/</a>   |
| Crop Ontology                                    | Yes  | Github: <a href="https://github.com/bioversity/Crop-Ontology">https://github.com/bioversity/Crop-Ontology</a>   |
| Environment Ontology                             | Yes  | <a href="https://code.google.com/p/envo/issues/list">https://code.google.com/p/envo/issues/list</a>   |
| Experimental Factor Ontology                     | Yes  | <a href="https://www.ebi.ac.uk/panda/jira/secure/CreateIssueDetails!init.jspx?pid=10421&amp;components=10875&amp;issuetype=2&amp;summary=EFO+content+requested+website&amp;description=Please+enter+your+name,+email+and+description+of+your+request.">https://www.ebi.ac.uk/panda/jira/secure/CreateIssueDetails!init.jspx?pid=10421&amp;components=10875&amp;issuetype=2&amp;summary=EFO+content+requested+website&amp;description=Please+enter+your+name,+email+and+description+of+your+request.</a> |
| Feature Annotation Location Description Ontology | Yes  | <a href="https://github.com/JervenBolleman/FALDO/issues">https://github.com/JervenBolleman/FALDO/issues</a>   |
| Phenotype And Trait Ontology                     | Yes  | <a href="http://sourceforge.net/p/obo/phenotypic-quality-pato-requests/">http://sourceforge.net/p/obo/phenotypic-quality-pato-requests/</a>   |
| Plant Experimental Conditions Ontology           | Yes  | <a href="https://sourceforge.net/p/obo/plant-environment-ontology-eo/">https://sourceforge.net/p/obo/plant-environment-ontology-eo/</a>   |
| Plant Ontology                                   | Yes  | <a href="https://sourceforge.net/p/obo/plant-ontology-po-term-requests/">https://sourceforge.net/p/obo/plant-ontology-po-term-requests/</a>   |
| Plant Trait Ontology                             | Yes  | <a href="https://sourceforge.net/p/obo/plant-trait-ontology-to-requests/">https://sourceforge.net/p/obo/plant-trait-ontology-to-requests/</a>   |
| Population and Community Ontology                | Yes  | <a href="https://code.google.com/p/popcomm-ontology/issues/list">https://code.google.com/p/popcomm-ontology/issues/list</a>   |

## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

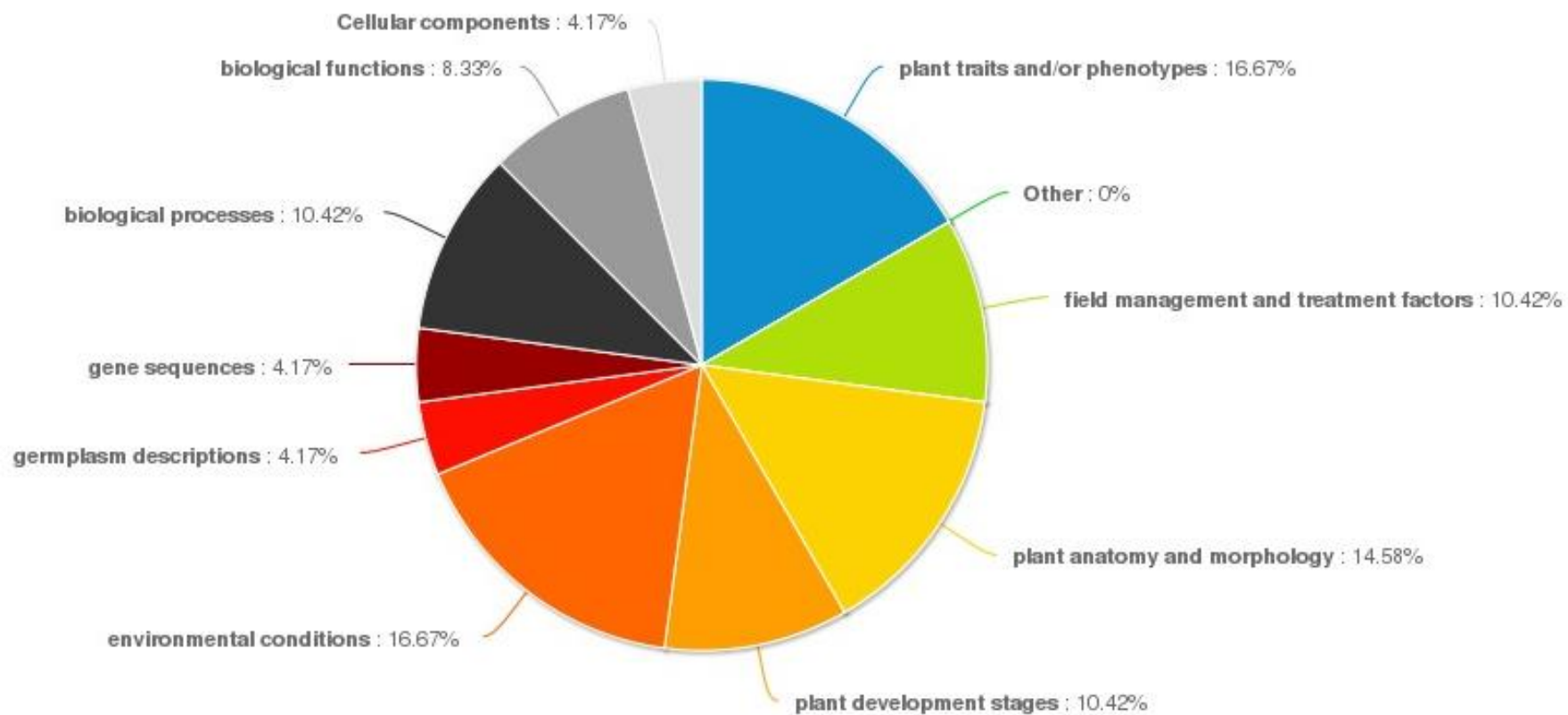
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|  |     |   |
|--|-----|---|
| Protein Ontology   | Yes | <a href="https://sourceforge.net/tracker/?group_id=266825&amp;atid=1135711">https://sourceforge.net/tracker/?group_id=266825&amp;atid=1135711</a> |
| Sequence Ontology  | Yes | <a href="http://sourceforge.net/p/song/term-tracker/">http://sourceforge.net/p/song/term-tracker/</a>   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Yes | Github: <a href="https://github.com/bioversity/Crop-Ontology">https://github.com/bioversity/Crop-Ontology</a>                                     |
| CAB Thesaurus  | No  |   |
| NAL Thesaurus  | No  |   |
| Variation Ontology   | No  |   |
| Wheat Ontology INRA  | No  |   |
| Wheat trait ontology:<br>Embedded in Crop Ontology   | No  |   |
| WheatPhenotype   | No  |   |

#### 14. What are the knowledge domains described by the ontology or vocabulary



| ontology or vocabulary   | 14. What are the knowledge domains described by the ontology or vocabulary   |
|--|--|
| AGROVOC  | field management and treatment factors plant anatomy and morphology environmental conditions biological processes biological functions   |
| CAB Thesaurus  | field management and treatment factors plant anatomy and morphology plant development stages environmental conditions biological processes biological functions Cellular components See <a href="http://www.cabi.org/cabthesaurus/mtwdk.exe?yi=coverage">http://www.cabi.org/cabthesaurus/mtwdk.exe?yi=coverage</a> for coverage |
| Cell Ontology  | non-plant eukaryotic cells   |
| Chemical Entities of Biological Interest   | chemical entities  |
| Crop Ontology  | plant traits and/or phenotypes field management and treatment factors plant anatomy and morphology environmental conditions germplasm descriptions   |
| Environment Ontology   | environmental conditions environments  |
| Experimental Factor Ontology   | plant anatomy and morphology plant development stages experimental variables, common and rare disease, cell lines  |
| Feature Annotation Location Description Ontology   | Locations of features on biological sequences  |
| NAL Thesaurus  | plant traits and/or phenotypes field management and treatment factors plant anatomy and morphology plant development stages environmental conditions biological processes biological functions Cellular components   |
| Phenotype And Trait Ontology   | plant traits and/or phenotypes   |
| Plant Experimental Conditions Ontology   | environmental conditions plant experimental conditions   |
| Plant Ontology   | plant anatomy and morphology plant development stages  |
| Plant Trait Ontology   | plant traits and/or phenotypes   |
| Population and Community Ontology  | biological processes collections of interacting organisms  |
| Protein Ontology   | Proteins   |
| Sequence Ontology  | gene sequences   |
| Variation Ontology   | gene sequences biological processes biological functions   |
| Wheat Ontology INRA  | plant traits and/or phenotypes   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | plant traits and/or phenotypes field management and treatment factors plant anatomy and morphology plant development stages environmental conditions germplasm descriptions  |

**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

*Wheat Data Interoperability Working Group (WDIWG)*

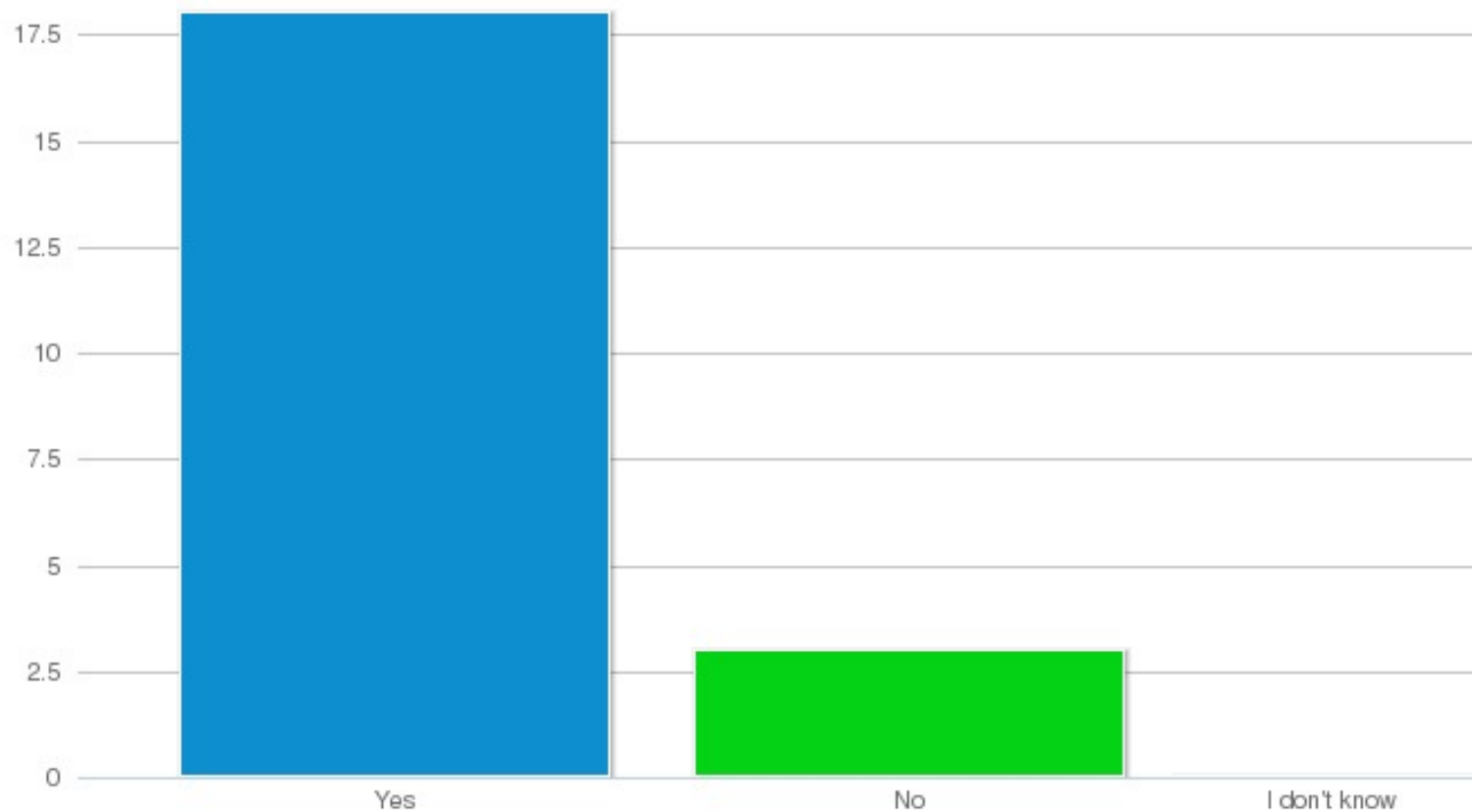
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*February 2015*



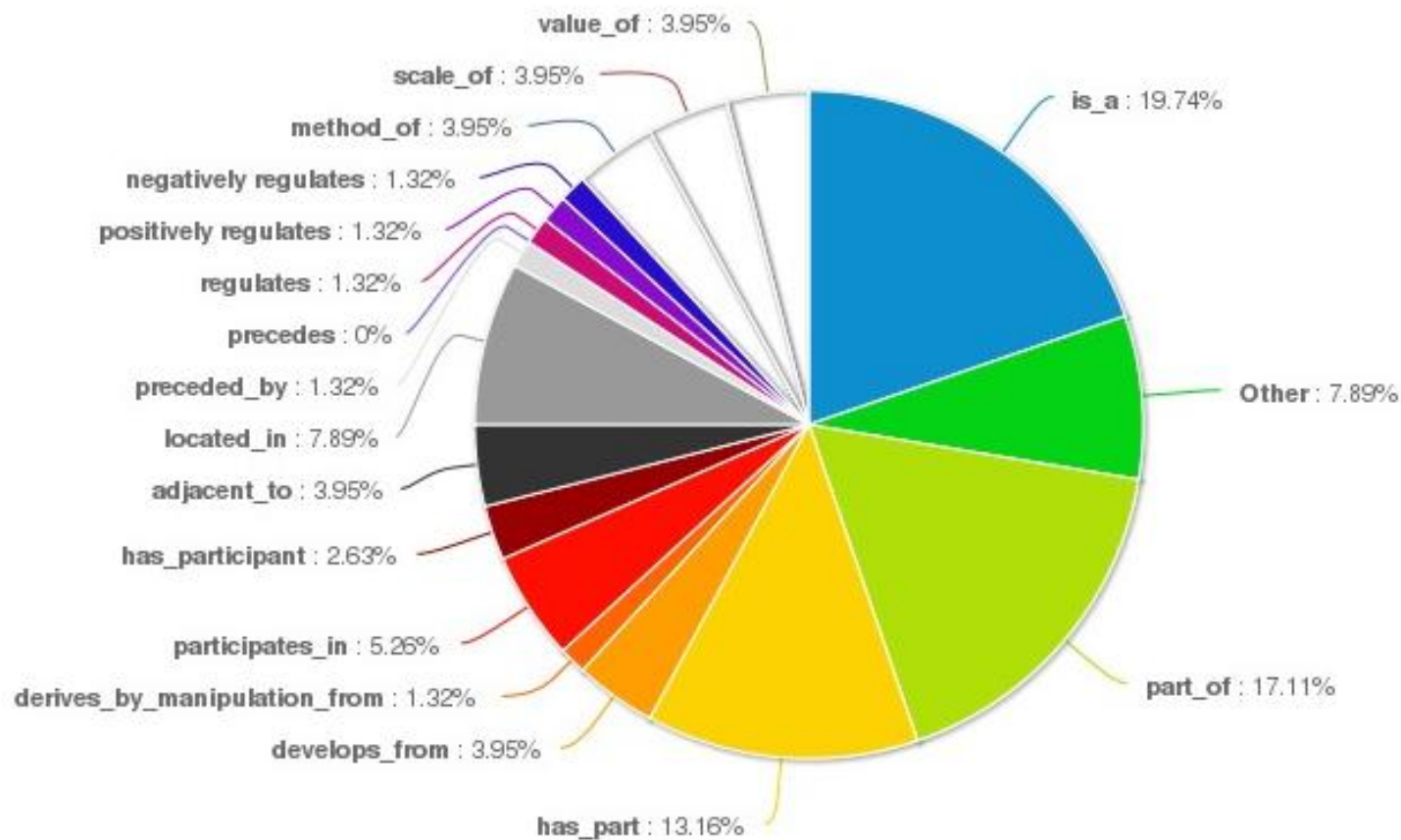
|   |   |
|---|---|
| Wheat trait ontology: Embedded in Crop Ontology | plant traits and/or phenotypes                          |
| WheatPhenotype                                  | plant traits and/or phenotypes environmental conditions |

15. Does the ontology/vocabulary use formal relationships based on RO, (the OBO Relations Ontology <https://code.google.com/p/obo-relations/>), or others?



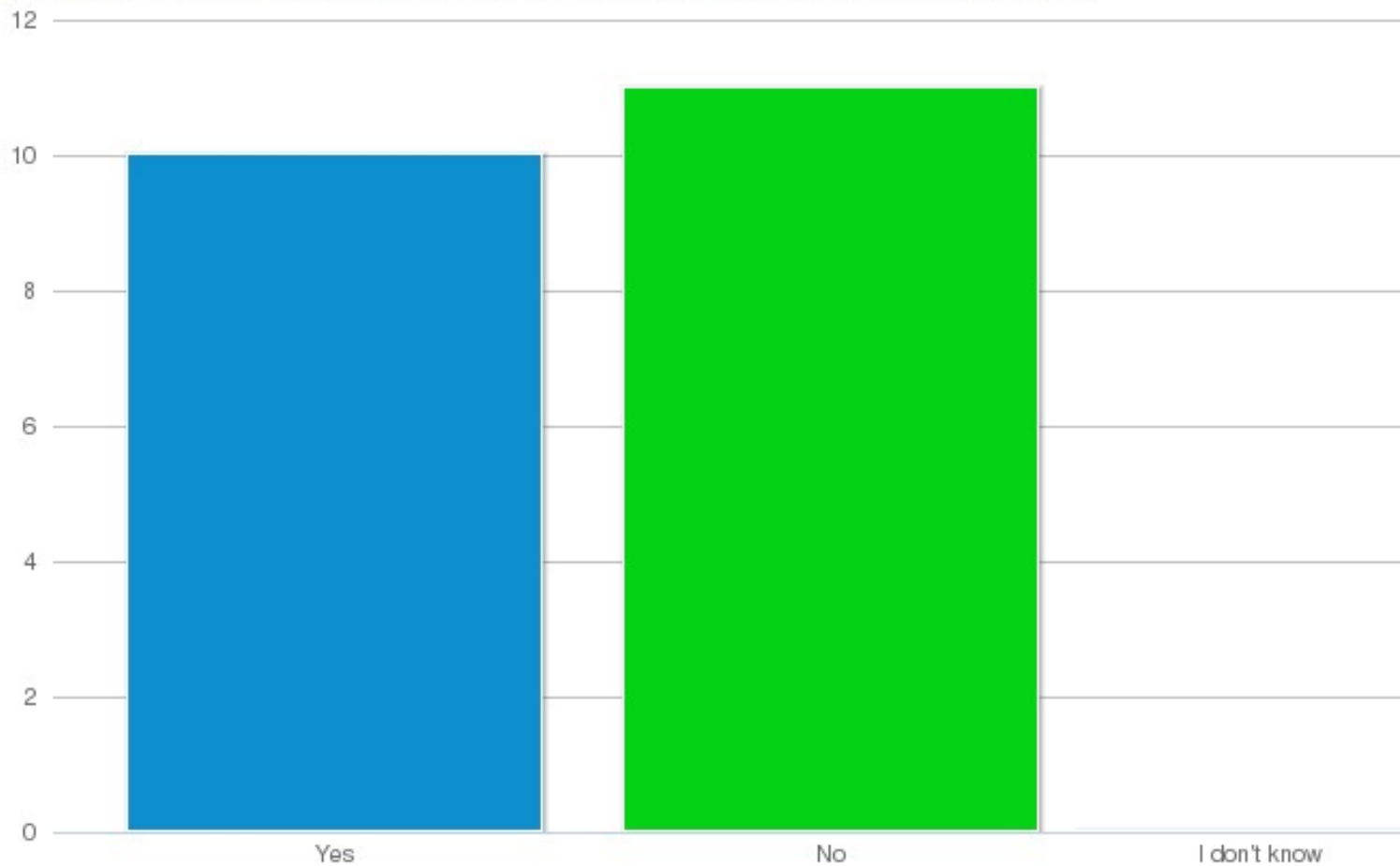


If so, please select from the relationships from the list

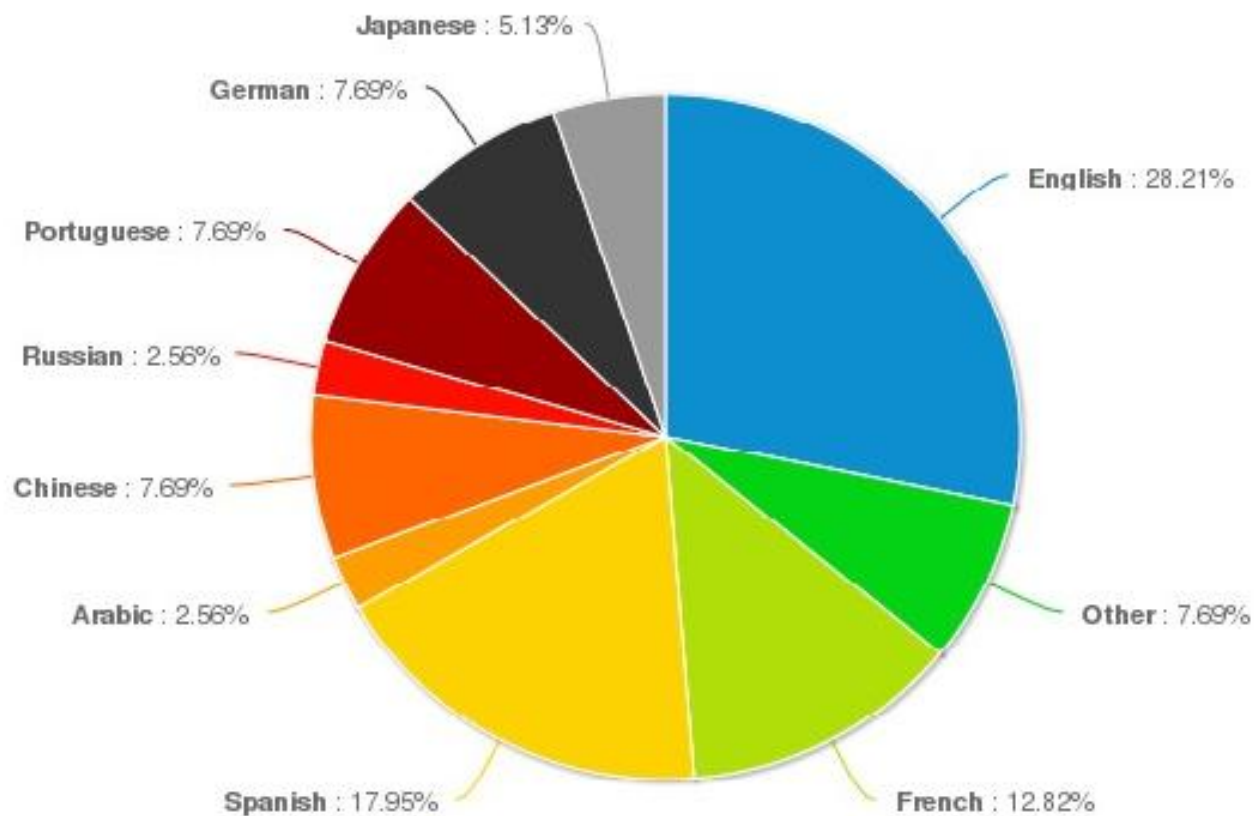


| ontology or vocabulary   | 15. Does it use formal relationships based on RO or others? | If so, please select from the relationships from the list   |
|--|---|---|
| WheatPhenotype   | Yes   | Other: causes   |
| Wheat trait ontology: Embedded in Crop Ontology  | Yes   | is_a part_of has_part method_of scale_of value_of   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | Yes   | is_a part_of method_of scale_of value_of  |
| Wheat Ontology INRA  | Yes   | Other: rdf:schema   |
| Variation Ontology   | Yes   | is_a part_of  |
| Sequence Ontology  | Yes   | is_a part_of Other: It also uses others but the plan is to migrate fully to RO  |
| Protein Ontology   | Yes   | is_a has_part participates_in located_in  |
| Population and Community Ontology  | Yes   | is_a part_of has_part participates_in has_participant located_in  |
| Plant Trait Ontology   | Yes   | is_a part_of has_part   |
| Plant Ontology   | Yes   | is_a part_of has_part develops_from derives_by_manipulation_from participates_in has_participant adjacent_to located_in preceded_by |
| Plant Experimental Conditions Ontology   | Yes   | is_a part_of  |
| Phenotype And Trait Ontology   | Yes   | is_a part_of has_part   |
| Experimental Factor Ontology   | Yes   | is_a part_of has_part develops_from participates_in located_in  |
| Environment Ontology   | Yes   | is_a part_of has_part adjacent_to located_in Other: determines  |
| Crop Ontology  | Yes   | is_a part_of method_of scale_of value_of  |
| Chemical Entities of Biological Interest   | Yes   | is_a has_part   |
| Cell Ontology  | Yes   | is_a part_of has_part develops_from adjacent_to located_in regulates positively regulates negatively regulates Other: capable_of    |
| AGROVOC  | Yes   | Other: SKOS, and an extension of skos:related   |
| NAL Thesaurus  | No  |   |
| Feature Annotation Location Description Ontology   | No  |   |
| CAB Thesaurus  | No  |   |

16. Do you offer the terms or concepts translated in different languages?



If so, what are they?



**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

Research Data Alliance (RDA)

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| ontology or vocabulary   | 16. Do you offer the terms or concepts translated in different languages? | If so, what are they?  |
|--|---|--|
| Plant Ontology   | Yes   | English Spanish Japanese   |
| Wheat trait ontology: Embedded in Crop Ontology  | Yes   | English Spanish Chinese Other: 1st version of ontology was translated in Chinese. Translation to Spanish is ongoing.   |
| NAL Thesaurus  | Yes   | English Spanish  |
| CAB Thesaurus  | Yes   | English French Spanish Portuguese German Other: Danish, Dutch, Finnish, Italian, Norwegian, Swedish  |
| Chemical Entities of Biological Interest   | Yes   | English French Spanish German  |
| Crop Ontology  | Yes   | English French Spanish Chinese Portuguese  |
| AGROVOC  | Yes   | English French Spanish Arabic Chinese Russian Portuguese German Japanese Other: total = 21: Arabic, Chinese, Czech, English, French, German, Hindi, Hungarian, Italian, Japanese, Korean, Lao, Persian, Polish, Portuguese, Russian, Slovak, Spanish, Thai, Turkish and Ukrainian. |
| Wheat Ontology INRA  | Yes   | English French   |
| Cell Ontology  | No  | Only English   |
| Environment Ontology   | No  | Only English   |
| Experimental Factor Ontology   | No  | Only English   |
| Feature Annotation Location Description Ontology   | No  | Only English   |
| Phenotype And Trait Ontology   | No  | Only English   |
| Plant Experimental Conditions Ontology   | No  | Only English   |
| Plant Trait Ontology   | No  | Only English   |
| Population and Community Ontology  | No  | Only English   |
| Protein Ontology   | No  | Only English   |
| Sequence Ontology  | No  | Only English   |
| Variation Ontology   | No  | Only English   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | No  | Only English   |
| WheatPhenotype   | No  | Only English   |

| ontology or vocabulary                   | 17. Please provide three example terms, classes or concepts from your ontology or vocabulary.  |
|--|--|
| AGROVOC                                  | <a href="http://aims.fao.org/aos/agrovoc/c_1167">http://aims.fao.org/aos/agrovoc/c_1167</a> <a href="http://aims.fao.org/aos/agrovoc/c_27694">http://aims.fao.org/aos/agrovoc/c_27694</a><br><a href="http://aims.fao.org/aos/agrovoc/c_49902">http://aims.fao.org/aos/agrovoc/c_49902</a>   |
| CAB Thesaurus                            | wheat; wheat loose smut; Phoma glomerata   |
| Cell Ontology                            | 'native cell' (CL:0000003) 'stem cell' (CL:0000034) 'CD2-positive, CD5-positive, CD44-positive alpha-beta intraepithelial T cell' (CL:0002037)   |
| Chemical Entities of Biological Interest | caffeine, CHEBI:27731 <a href="http://www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:27732">www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:27732</a> L-isoleucine, CHEBI:17191<br><a href="http://www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:17191">http://www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:17191</a> dutasteride, CHEBI:521033<br><a href="http://www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:521033">http://www.ebi.ac.uk/chebi/searchId.do?chebiid=CHEBI:521033</a>   |
| Crop Ontology                            | Trait Class: Stress Trait Trait:Drought Tolerance Method: DroughtTol determination scale: 1-5 scale values: 1 - highly susceptible   |
| Environment Ontology                     | In OBO format... [Term] id: ENVO:00000020 name: lake def: "A body of water or other liquid of considerable size contained on a body of land." [Wikipedia:Lake] synonym: "broad" RELATED [] synonym: "catch basin" NARROW [USGS:SDTS] synonym: "LAKE" EXACT [USGS:SDTS] synonym: "Lake" EXACT [NASA:earthrealm] synonym: "lake" EXACT [Geonames:feature] synonym: "lakes" EXACT [Geonames:feature] synonym: "llyn" RELATED [] synonym: "loch" RELATED [] synonym: "lochan" RELATED [ADL:FTT] synonym: "lough" RELATED [] synonym: "mere" RELATED [] synonym: "mortlake" RELATED [USGS:SDTS] synonym: "open water" NARROW [USGS:SDTS] synonym: "pasteur lake" RELATED [USGS:SDTS] synonym: "tarn" NARROW [ADL:FTT] xref: EcoLexicon:lake xref: FTT:221 xref: FTT:704 xref: FTT:909 xref: Geonames:H.LK xref: Geonames:H.LKS xref: SPIRE:Lake_or_pond xref: SWEETRealm:Lake xref: TGN:21114 xref: TGN:21115 xref: Wikipedia:Lake is_a: ENVO:00000063 ! water body [Term] id: ENVO:00000428 name: biome def: "A biome is an environmental system to which resident ecological communities have evolved adaptations." [DOI:10.1186/2041-1480-4-43, Wikipedia:Biome] comment: This class is currently being aligned to the Basic Formal Ontology. Following this alignment, its definition and the definitions of its subclasses will be revised. synonym: "ecosystem" RELATED [] synonym: "EcosystemType" RELATED [NASA:earthrealm] synonym: "major habitat type" EXACT [WWF:Biome] xref: EcoLexicon:biome xref: Wikipedia:Biome is_a: ENVO:01000254 ! environmental system disjoint_from: ENVO:01000276 ! ecoregion disjoint_from: ENVO:01000280 ! ecozone [Term] id: ENVO:00002236 name: cryosol def: "Cryosols comprise mineral soils formed in a permafrost environment. Where water is present, it occurs primarily in the form of ice. Cryogenic processes are the dominant soil-forming processes." [FAO: <a href="http://fao.org/ag/agl/agll/wrb/doc/wrb2006final.pdf">http://fao.org/ag/agl/agll/wrb/doc/wrb2006final.pdf</a> ] synonym: "gelisol" RELATED [] xref: Wikipedia:Cryosol relationship: part_of ENVO:00000134 ! permafrost |

## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

Research Data Alliance (RDA)

February 2015



|  |   |
|--|---|
| Experimental Factor Ontology   | genetic disorder autosomal trisomy Karpas 422 cell line   |
| Feature Annotation Location  |   |
| Description Ontology   |   |
| NAL Thesaurus  | wheat protein hydrolysates wheat classes Wheat yellow mosaic virus  |
| Phenotype And Trait Ontology   |   |
| Plant Experimental Conditions Ontology   | 1. plant treatment (EO:0001001): A plant experimental condition (EO:0007359) or set of conditions describing the application of an abiotic (EO:0007191) or biotic plant treatment (EO:0007357) or the combinatorial application thereof. 2. study type (EO:0007231): A plant experimental condition (EO:0007359) or set of conditions describing what kind of plant growth facility was used for the experiment. 3. stratification treatment (EO:0001035): A physical treatment (EO:0007316) involving both low temperature and moist conditions to overcome seed dormancy.                       |
| Plant Ontology   | 1. leaf (PO:0025034): A phyllome (PO:0006001) that is not associated with a reproductive structure. 2. whole plant (PO:0000003): A plant structure (PO:0005679) which is a whole organism. 3. plant organ development stage (PO:0025339): A plant structure development stage that has as primary participant a plant organ.  |
| Plant Trait Ontology   | 1. plant trait (TO:0000387): A measurable or observable characteristic of a cellular component (GO:0005575), biological process (GO:0008150) or molecular function (GO:0003674) that is part of, or has participant a plant anatomical entity (PO:0025131) and/or a plant structure development stage (PO:0009012). 2. seed shape (TO:0000484): A seed anatomy and morphology trait (TO:0000184) which is associated with the shape of a seed (PO:0009010). 3. fruit yield trait (TO:0000871): A shoot system yield trait (TO:0000327) which is associated with the yield of fruits (PO:0009001). |
| Population and Community Ontology  | collection of organism ecological community population process  |
| Protein Ontology   | PR:000000651 "smad2 isoform 1 phosphorylated 2" PR:000025935 "smad2 isoform 1 phosphorylated 2 (human)" PR:000025946 "smad2-smad4 protein complex 3 (human)"  |
| Sequence Ontology  | siRNA, exon, retrotransposon  |
| Variation Ontology   | [Term] id: VariO:0001 name: variation def: "Alteration in DNA, RNA or protein." [VariO:mv] [Term] id: VariO:0002 name: variation affecting protein def: "Effects of a variation on protein level." [VariO:mv] is_a: VariO:0001 ! variation [Term] id: VariO:0003 name: variation affecting protein function def: "Effect of variation on protein function." [VariO:mv] is_a: VariO:0002 ! variation affecting protein   |
| Wheat Ontology INRA  | cold sensibility Ear emergence, Z25 Grain dry matter / biomasse grain à maturité sur botillon   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | [Term] id: CO_121:0000004 name: 3 stem elongation xref: GRO:0007080 is_a: CO_121:0000000 ! CGIAR Wheat Plant Anatomy and Development Ontology [Term] id: CO_715:0000010 name: Harvest finishing date def: "Date of harvest finishing." [CO:rs] is_a: CO_715:0000008 ! Harvest date created_by: RSHRESTHA creation_date: 2010-02-10T02:40:17Z  |

**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

Research Data Alliance (RDA)

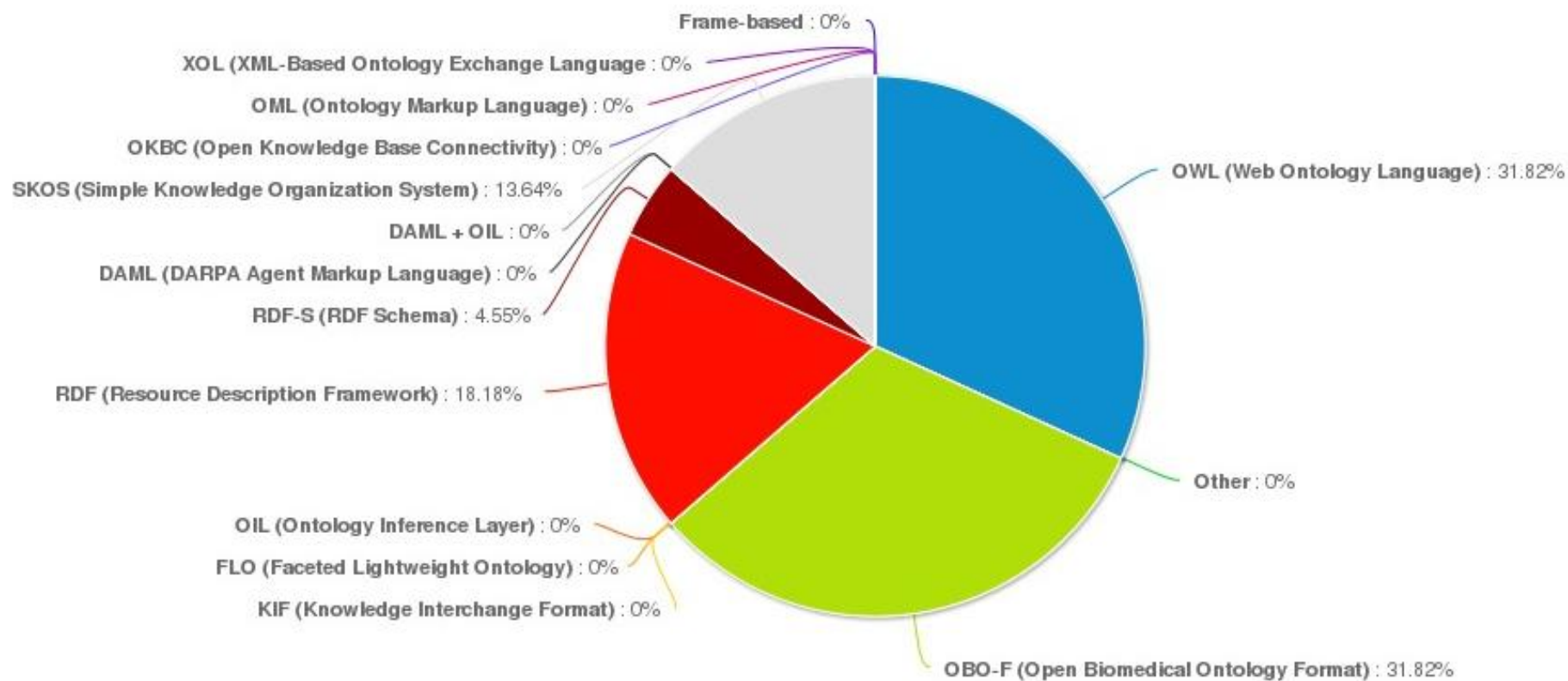
February 2015



|  |  |
|--|--|
| <p>Wheat trait ontology: Embedded in Crop Ontology</p> | <p>name: Stripe rust def: "Scored for stripe rust incidence/severity/response in the plants caused by the agent Puccinia striiformis f.sp. Tritici." [CO:rs] synonym: "PSTRISEV" RELATED [] synonym: "yellow rust" RELATED [] is_a: CO_321:0000133 ! Rust [Term] id: CO_321:0000375 name: Field response McNEAL scoring def: "Response (type of disease reaction) in adult plant to stripe rust, refers to the infection type and is classified according to the MCNEAL scale." [] relationship: method_of CO_321:0000129 ! Stripe rust [Term] id: CO_321:0000466 name: 0-9 Mc Neal scale is_a: CO_321:0000409 ! Unit relationship: scale_of CO_321:0000375 ! Field response McNEAL scoring</p>  |
| <p>WheatPhenotype</p>                                  | <p>[Term] id: ID:00000388 name: Colletotrichum graminicola synonym: "Colletotrichopsis graminicola" EXACT [] synonym: "Di cladium graminicola" EXACT [] synonym: "Di cladium graminicolum" EXACT [] synonym: "Glomerella graminicola" EXACT [] synonym: "Steirochaete graminicola" EXACT [] is_a: ID:0000239 ! fungi Term] id: ID:00000342 name: anthracnose is_a: ID:0000244 ! fungal disease relationship: causes ID:00000388 ! Colletotrichum graminicola created_by: Claire Nédellec creation_date: 2015-02-03T10:07:56Z Term] id: WP:0000009 name: resistance to Anthracnose synonym: "resistance to Colletotrichum graminicola" NARROW [] synonym: "resistance to Glomerella graminicola" NARROW [] is_a: ID:0031083 ! resistance to a fungal pathogen created_by: Claire Nédellec creation_date: 2010-11-17T07:22:05Z</p> |



18. In which of the following languages or standards is the ontology or vocabulary available?



**Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat**

Wheat Data Interoperability Working Group (WDIWG)

Research Data Alliance (RDA)

February 2015



| ontology or vocabulary                           | 18. In which of the following languages or standards is the ontology or vocabulary available?  |
|--|--|
| AGROVOC  | RDF (Resource Description Framework)<br>SKOS (Simple Knowledge Organization System)  |
| CAB Thesaurus                                    | RDF (Resource Description Framework)<br>SKOS (Simple Knowledge Organization System)  |
| Cell Ontology                                    | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Chemical Entities of Biological Interest         | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Crop Ontology                                    | OBO-F (Open Biomedical Ontology Format)<br>RDF (Resource Description Framework)<br>RDF-S (RDF Schema)<br>SKOS (Simple Knowledge Organization System)<br>csv and OWL can be obtained from conversion of OBO or SKOs formats |
| Environment Ontology                             | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)<br>RDF (Resource Description Framework)   |
| Experimental Factor Ontology                     | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)<br>RDF (Resource Description Framework)   |
| Feature Annotation Location Description Ontology | OWL (Web Ontology Language)<br>RDF (Resource Description Framework)<br>RDF-S (RDF Schema)  |
| NAL Thesaurus                                    | SKOS (Simple Knowledge Organization System)  |
| Phenotype And Trait Ontology                     | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Plant Experimental Conditions Ontology           | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Plant Ontology                                   | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |

## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

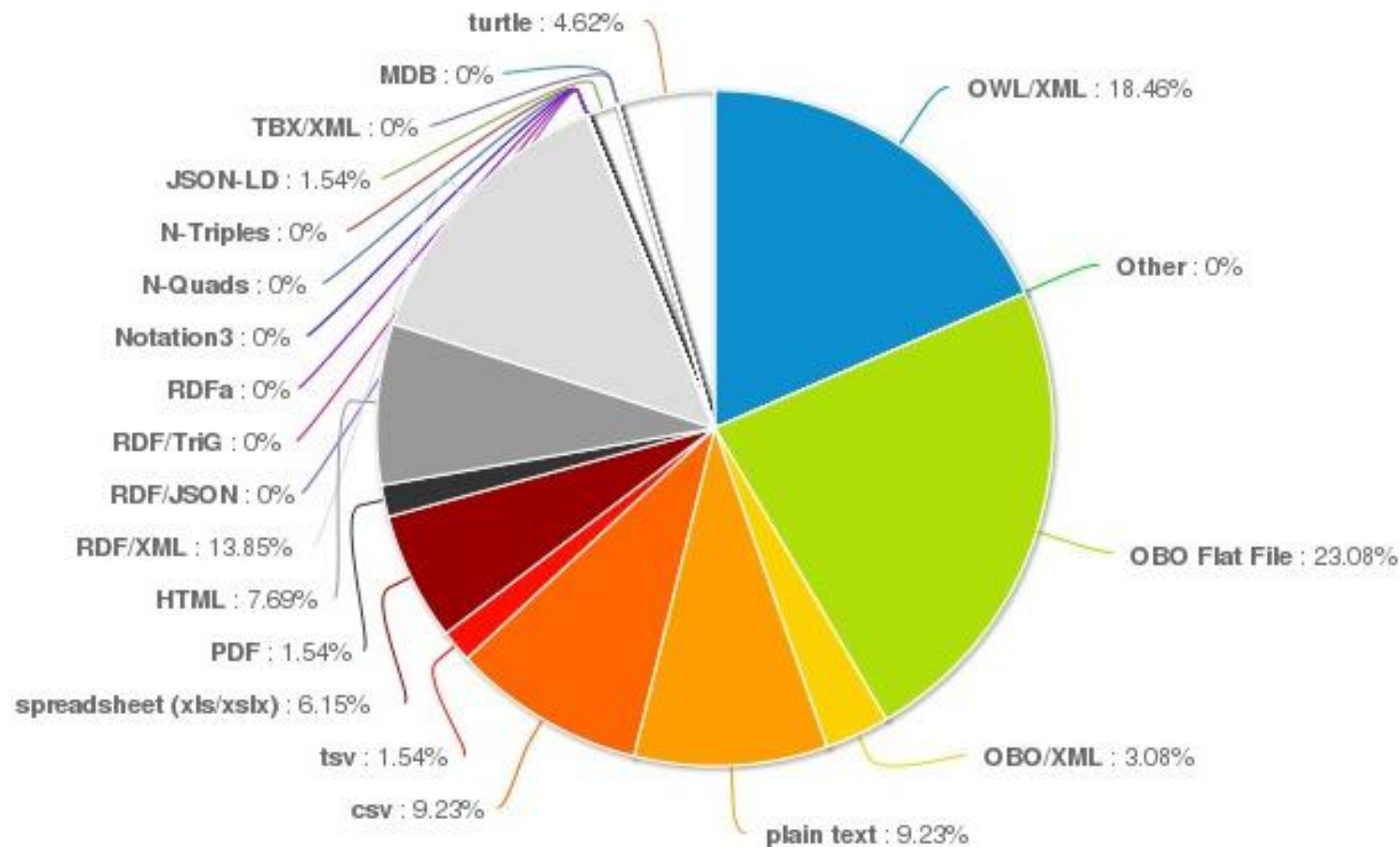
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|   |  |
|---|--|
| Plant Trait Ontology  | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Population and Community Ontology   | OWL (Web Ontology Language)  |
| Protein Ontology  | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Sequence Ontology   | OWL (Web Ontology Language)<br>OBO-F (Open Biomedical Ontology Format)   |
| Variation Ontology  | OWL (Web Ontology Language)  |
| Wheat Ontology INRA   | OWL (Web Ontology Language)<br>SKOS (Simple Knowledge Organization System)   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology<br>(both are part of Crop Ontology, CO) | OBO-F (Open Biomedical Ontology Format)<br>RDF (Resource Description Framework)<br>SKOS (Simple Knowledge Organization System)<br>RDF-S (RDF Schema)<br>csv and OWL can be obtained from conversion of OBO or SKOs formats |
| Wheat trait ontology: Embedded in Crop Ontology   | OBO-F (Open Biomedical Ontology Format)<br>RDF (Resource Description Framework) Excel  |
| WheatPhenotype  | OBO-F (Open Biomedical Ontology Format)  |

### 19. What media types for distribution do you use?



## Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

Wheat Data Interoperability Working Group (WDIWG)

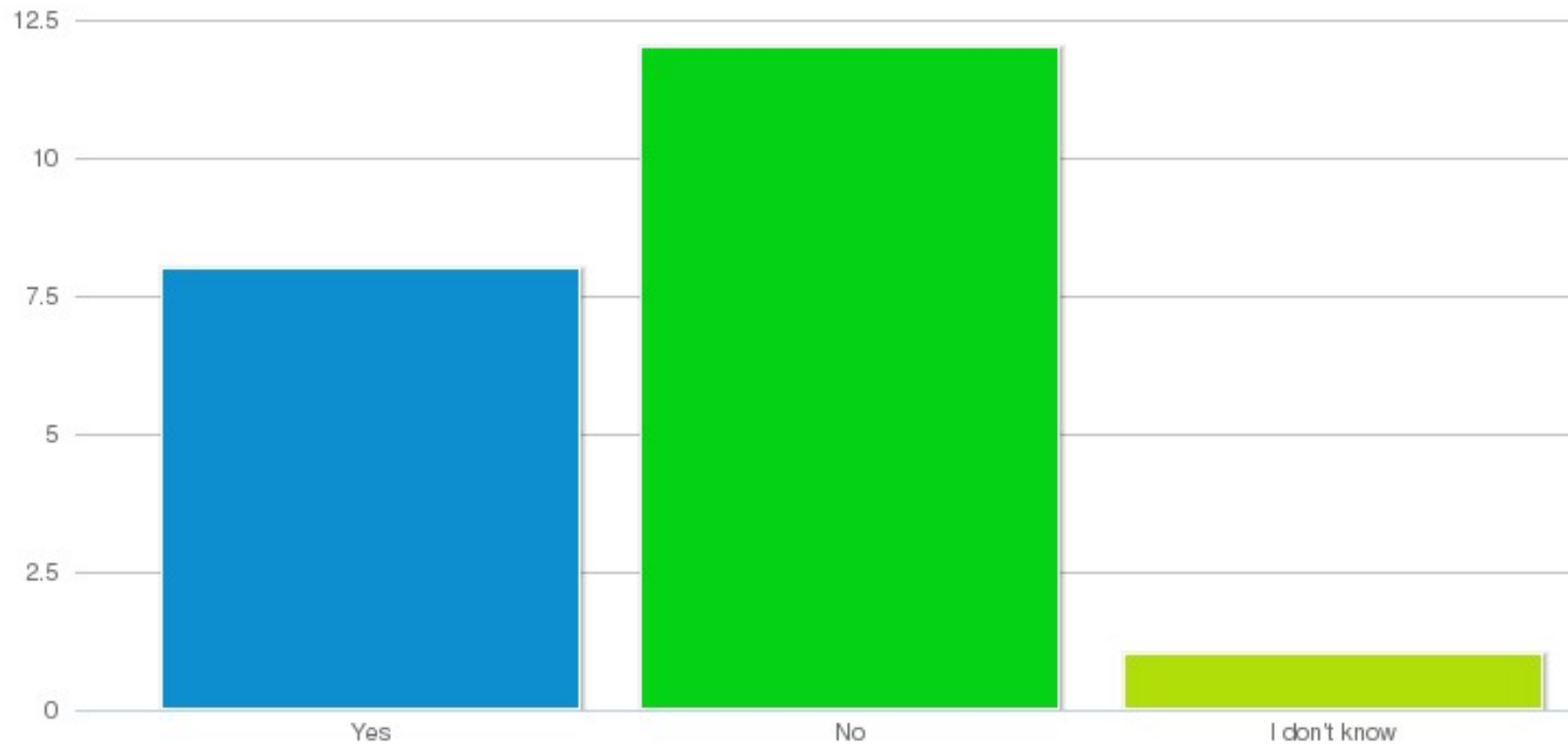
Research Data Alliance (RDA)

February 2015

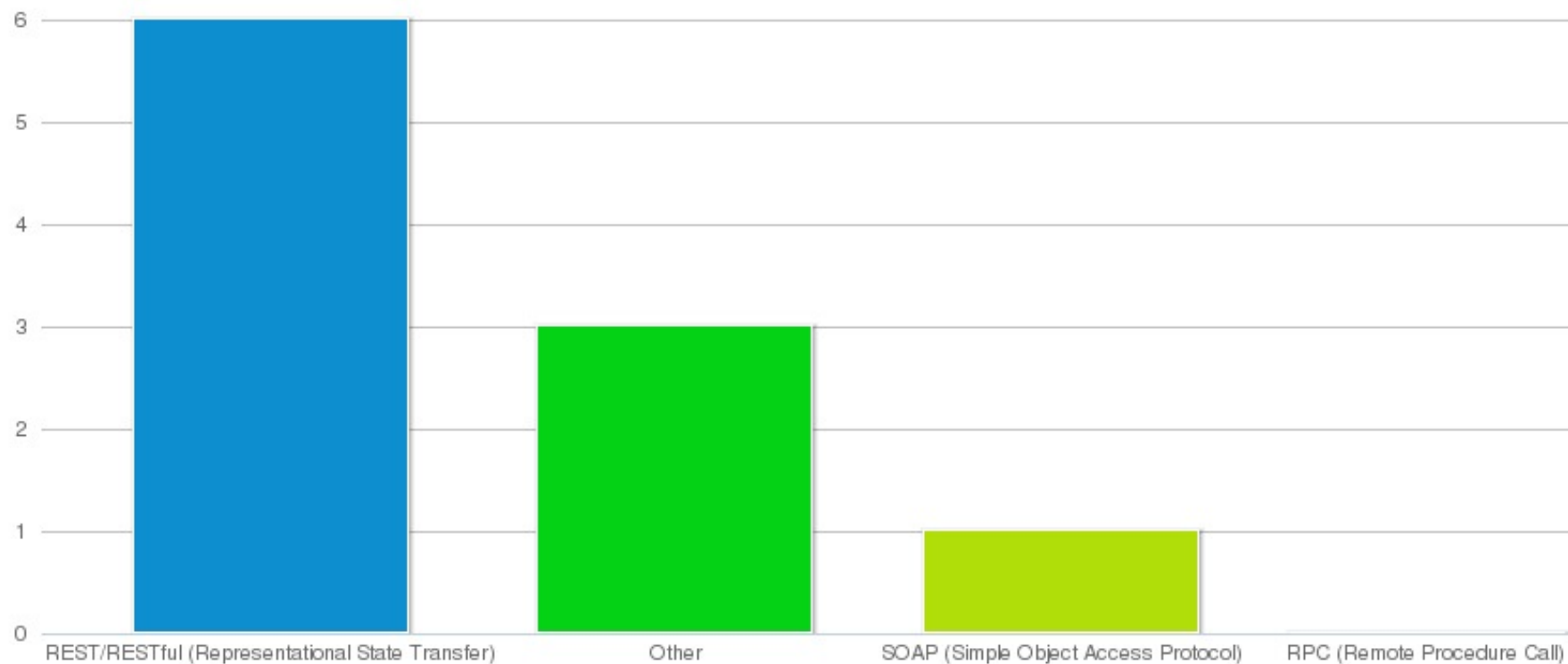


| ontology or vocabulary   | 19. What media types for distribution do you use?                 |
|--|---|
| AGROVOC  | RDF/XML trix  |
| CAB Thesaurus  | plain text csv spreadsheet (xls/xlsx) HTML RDF/XML                |
| Cell Ontology  | OWL/XML OBO Flat File   |
| Chemical Entities of Biological Interest   | OWL/XML OBO Flat File tsv HTML                                    |
| Crop Ontology  | OBO Flat File csv spreadsheet (xls/xlsx) HTML RDF/XML turtle JSON |
| Environment Ontology   | OWL/XML OBO Flat File plain text csv                              |
| Experimental Factor Ontology   | OWL/XML OBO Flat File RDF/XML                                     |
| Feature Annotation Location Description Ontology   | HTML RDF/XML  |
| NAL Thesaurus  | plain text PDF RDF/XML US MARC                                    |
| Phenotype And Trait Ontology   | OWL/XML OBO Flat File OBO/XML                                     |
| Plant Experimental Conditions Ontology   | OWL/XML OBO Flat File plain text csv                              |
| Plant Ontology   | OWL/XML OBO Flat File plain text                                  |
| Plant Trait Ontology   | OWL/XML OBO Flat File plain text csv                              |
| Population and Community Ontology  | OWL/XML RDF/XML turtle  |
| Protein Ontology   | OWL/XML OBO Flat File   |
| Sequence Ontology  | OWL/XML OBO Flat File   |
| Variation Ontology   | OWL/XML OBO Flat File OBO/XML                                     |
| Wheat Ontology INRA  | spreadsheet (xls/xlsx)  |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | OBO Flat File csv HTML RDF/XML JSON-LD turtle                     |
| Wheat trait ontology: Embedded in Crop Ontology  | OBO Flat File spreadsheet (xls/xlsx) RDF/XML                      |
| WheatPhenotype   | OBO Flat File   |

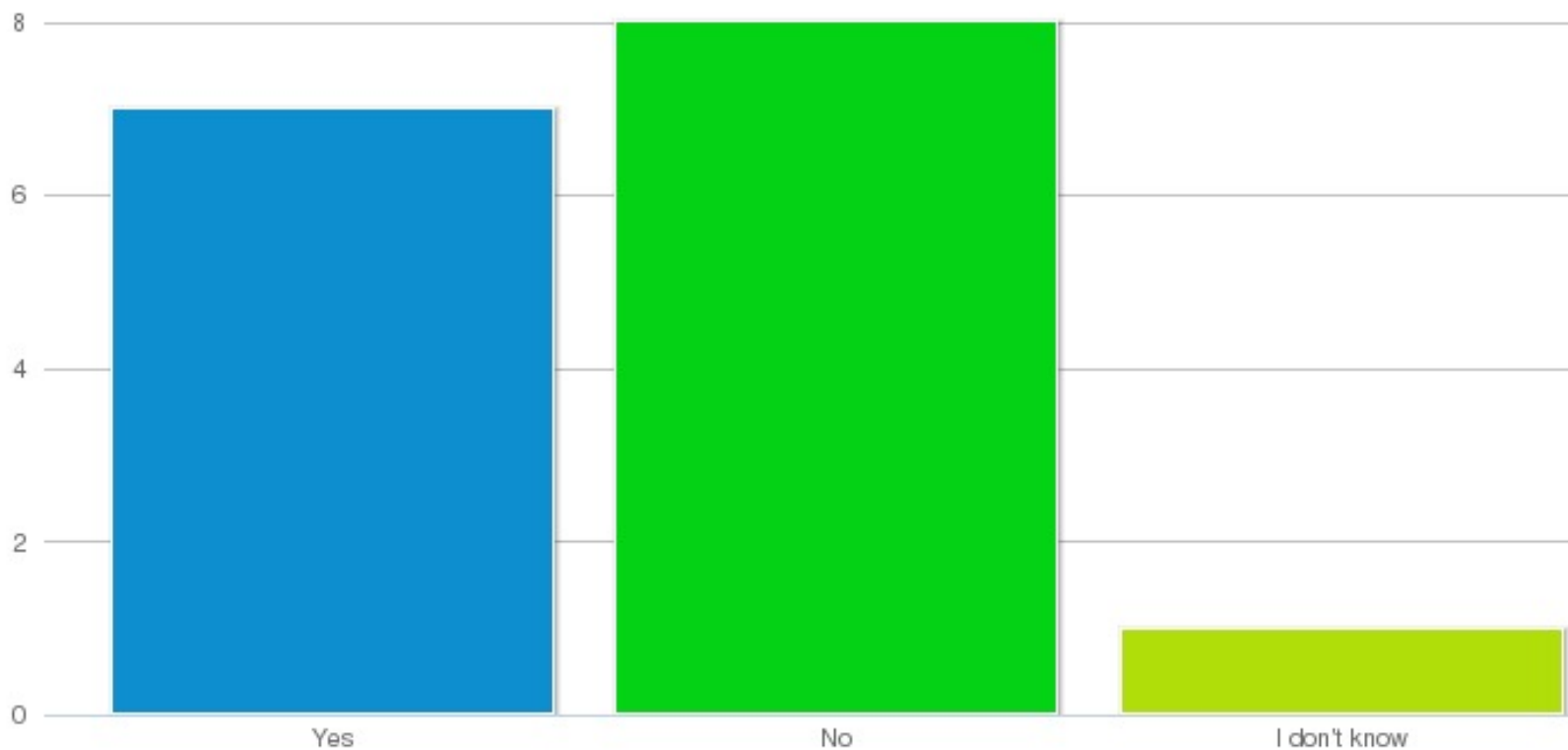
## 20. Is your ontology or vocabulary accessible through web services?



20a. If so, which protocol(s) or architecture(s) do your web services use?



### 20b. Do your web services provide a public API (Application Programming Interface)?





| ontology or vocabulary   | 20. Is it accessible through web services? | If yes, please provide the URL:   | 20a. If so, which protocol(s) or architecture(s) do your web services use? | 20b. Do your web services provide a public API (Application Programming Interface)? | If yes, please provide the URL for the API documentation::  |
|--|--|---|--|---|---|
| Chemical Entities of Biological Interest                       | Yes  |   | SOAP (Simple Object Access Protocol)                                       | Yes   | <a href="http://www.ebi.ac.uk/chebi/developerManualForward.do">http://www.ebi.ac.uk/chebi/developerManualForward.do</a> |
| AGROVOC  | Yes  | <a href="https://aims-fao.atlassian.net/wiki/display/AGV/WEB+SERVICES">https://aims-fao.atlassian.net/wiki/display/AGV/WEB+SERVICES</a> | REST/RESTful (Representational State Transfer) Other: fed by the rdf       | Yes   | <a href="http://agrovoc.fao.org/axis/services/SKOSWS?wsdl">http://agrovoc.fao.org/axis/services/SKOSWS?wsdl</a>         |
| Crop Ontology  | Yes  | <a href="http://www.cropontology.org/api">http://www.cropontology.org/api</a>   | REST/RESTful (Representational State Transfer)                             | Yes   | <a href="http://www.cropontology.org/api">http://www.cropontology.org/api</a>   |
| Experimental Factor Ontology                                   | Yes  | <a href="http://data.bioontology.org">http://data.bioontology.org</a>   | REST/RESTful (Representational State Transfer)                             | Yes   | <a href="http://data.bioontology.org/documentation">http://data.bioontology.org/documentation</a>                       |
| Feature Annotation Location Description Ontology               | Yes  | <a href="http://biohackathon.org/resource/faldo">http://biohackathon.org/resource/faldo</a>   | REST/RESTful (Representational State Transfer)                             | No  |   |
| Plant Ontology   | Yes  |   | REST/RESTful (Representational State Transfer)                             | Yes   | <a href="http://www.plantontology.org/software/po_webservices">http://www.plantontology.org/software/po_webservices</a> |
| Wheat Plant Anatomy and Development Ontology and Crop Research | Yes  | <a href="http://www.cropontology.org/ontology/api">http://www.cropontology.org/ontology/api</a>   | REST/RESTful (Representational State Transfer)                             | Yes   | <a href="http://www.cropontology.org/api">http://www.cropontology.org/api</a>   |

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Research Data Alliance (RDA)

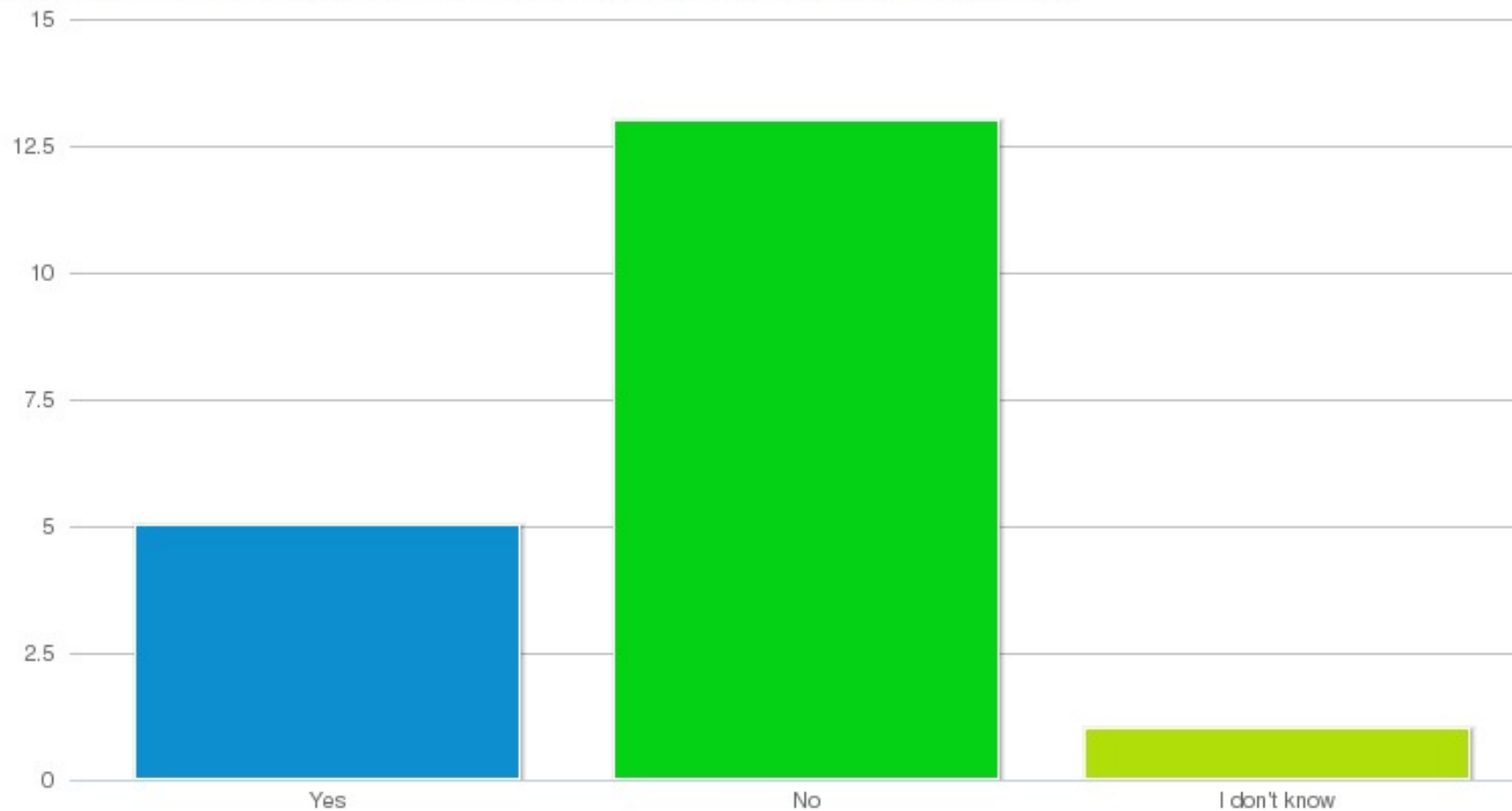
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|  |              |   |   |              |   |
|--|--------------|---|---|--------------|---|
| ontology (both are part of Crop Ontology, CO)      |              |   |   |              |   |
| Wheat trait ontology:<br>Embedded in Crop Ontology | Yes          | <a href="http://www.cropontology.org/ontology/CO_321/Wheat">http://www.cropontology.org/ontology/CO_321/Wheat</a> | Other: No idea  | Yes          | <a href="http://www.cropontology.org/api">http://www.cropontology.org/api</a> |
| CAB Thesaurus                                      | No           |   |   | No           |   |
| Cell Ontology                                      | No           |   |   |              |   |
| Environment Ontology                               | No           |   |   | No           |   |
| NAL Thesaurus                                      | No           |   |   | No           |   |
| Phenotype And Trait Ontology                       | No           |   |   | I don't know |   |
| Plant Experimental Conditions Ontology             | No           |   |   |              |   |
| Plant Trait Ontology                               | No           |   |   |              |   |
| Population and Community Ontology                  | No           |   |   | No           |   |
| Protein Ontology                                   | No           |   |   |              |   |
| Variation Ontology                                 | No           |   |   | No           |   |
| Wheat Ontology INRA                                | No           |   |   | No           |   |
| WheatPhenotype                                     | No           |   |   | No           |   |
| Sequence Ontology                                  | I don't know |   | Other: The ontology is available via aggregative sites such as NCBO |              |   |

|  |  |  |                                       |  |  |
|--|--|--|---------------------------------------|--|--|
|  |  |  | which provide some of these services. |  |  |
|--|--|--|---------------------------------------|--|--|

### 21. Is your ontology or vocabulary accessible through a SPARQL Endpoint?



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| ontology or vocabulary   | 21. Is it accessible through a SPARQL Endpoint? | If yes, please provide the URL:   |
|--|---|---|
| Protein Ontology   | Yes   |   |
| Population and Community Ontology  | Yes   |   |
| Experimental Factor Ontology   | Yes   | <a href="http://sparql.bioontology.org/">http://sparql.bioontology.org/</a>   |
| Cell Ontology  | Yes   |   |
| AGROVOC  | Yes   | <a href="http://202.45.139.84:10035/catalogs/fao/repositories/agrovoc">http://202.45.139.84:10035/catalogs/fao/repositories/agrovoc</a> |
| WheatPhenotype   | No  |   |
| Wheat trait ontology: Embedded in Crop Ontology  | No  |   |
| Wheat Plant Anatomy and Development Ontology and Crop Research ontology (both are part of Crop Ontology, CO) | No  |   |
| Wheat Ontology INRA  | No  |   |
| Variation Ontology   | No  |   |
| Plant Trait Ontology   | No  |   |
| Plant Ontology   | No  |   |
| Plant Experimental Conditions Ontology   | No  |   |
| Phenotype And Trait Ontology   | No  |   |
| NAL Thesaurus  | No  |   |
| Crop Ontology  | No  |   |
| Chemical Entities of Biological Interest   | No  |   |
| CAB Thesaurus  | No  |   |
| Feature Annotation Location Description Ontology   | I don't know                                    |   |
| Sequence Ontology  |   |   |
| Environment Ontology   |   |   |

## Annex 1. Towards a Comprehensive Overview of Ontologies and Vocabularies for Research on Wheat

**\* Required**

**1. Name of the ontology or vocabulary\***

**2. Alternative name or acronym\***

**3. Contact person\***

**First Name\***

**Last Name\***

**4. Contact e-mail\***

**5. URL(s) of the ontology or vocabulary\***

**6. Who or what organization is supporting the ontology or vocabulary?**

e.g. project, research group, research organization, university, others..

**7. Is your ontology or vocabulary regularly maintained and updated\***

Yes  No  I don't know

**If yes, do you have a regular release schedule?**

**8. What License and/or Copyright is used?\***

- CC BY - Creative Commons Attribution
- CC BY-ND - Creative Commons Attribution-NoDerivs
- CC BY-NC-SA - Creative Commons Attribution-NonCommercial-ShareAlike
- CC BY-SA - Creative Commons Attribution-ShareAlike
- CC BY-NC - Creative Commons Attribution-NonCommercial
- CC BY-NC-ND - Creative Commons Attribution-NonCommercial-NoDerivs
- CC BY 4.0 - Creative Commons Attribution 4.0 International
- CC0 1.0 Universal - Creative Commons Universal
- ODC-BY - Open Data Commons Attribution License
- ODbL - Open Data Commons Open Database License
- Public Domain Mark
- None
- Other:

**9. Please list any relevant publications about the ontology or vocabulary:**

## Visibility and Interoperability

This section will help us to collect information about the use and interoperability of your ontology or vocabulary within the research community.

### 10. Is the ontology or vocabulary part of any ontology communities or listing services?\*

- Crop Ontology Curation Tool (CO; <http://www.croponontology.org>)
- European Bioinformatics Institute- Ontology Look-up Service (EBI-OLS; <http://www.ebi.ac.uk/ontology-lookup/>)
- Linked Open Vocabularies (LOV; <http://lov.okfn.org/dataset/lov/>)
- National Center for Biomedical Ontology (NCBO; Bioportal <http://www.bioontology.org/BioPortal>)
- OntoBee (<http://www.ontobee.org/index.php>)
- Open Biological and Biomedical Ontologies (OBO\_Foundry; <http://www.obofoundry.org/>)
- Semanticweb.org (<http://semanticweb.org/wiki/Ontology>)
- Other:  Other Value

### 11. Is your ontology or vocabulary used or implemented in any database/repository?\*

- Yes  No  I don't know

If yes, please list them:





**12. Do you interlink and/or map to other ontologies or vocabularies (extends, maps, etc.)\***

Yes  No  I don't know

**12a. What is the main purpose of mapping your ontology or vocabulary to other resources?**

- data mining
- data sharing
- ontology merging
- query translations
- web service integration (web content mining)
- Other:  Other Value

**12b. What mapping tools have you used? Please mention the name of the tool**

- STROMA
- S-Match
- Aroma
- Loom (Lexical OWL Ontology Matcher)
- COMA++
- Chimaera

- FOAM
- MoA Shell
- OLA
- ROMPT
- QOM
- Taxomap
- manually
- Other:  Other Value

**13. Does the ontology/vocabulary have a term or issue tracker, such as those on SourceForge or GoogleCode?\***

- Yes  No  I don't know

**If so, please provide URL.**

## Domain and Content

This section will help us to understand the knowledge domains covered in your ontology or vocabulary, and about the types of relationships between concepts.

**14. What are the knowledge domains described by the ontology or vocabulary\***

- plant traits and/or phenotypes
- field management and treatment factors
- plant anatomy and morphology

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- plant development stages
- environmental conditions
- germplasm descriptions
- gene sequences
- biological processes
- biological functions
- Cellular components
- Other:  Other Value

**15. Does the ontology/vocabulary use formal relationships based on RO, (the OBO Relations Ontology <https://code.google.com/p/obo-relations/>), or others?\***

- Yes  No  I don't know

**If so, please select from the relationships from the list**

- is\_a
- part\_of
- has\_part
- develops\_from
- derives\_by\_manipulation\_from
- participates\_in
- has\_participant

- adjacent\_to
- located\_in
- preceded\_by
- precedes
- regulates
- positively regulates
- negatively regulates
- method\_of
- scale\_of
- value\_of
- Other:  Other Value

Note: some ontologies might be using specific relationships. For instance, CO uses relationships like method\_of, scale\_of, value\_of.

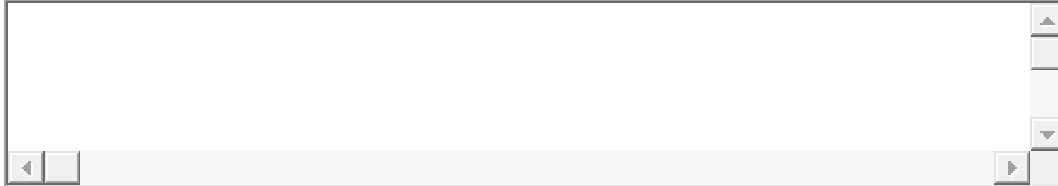
**16. Do you offer the terms or concepts translated in different languages?\***

- Yes  No  I don't know

**If so, what are they?**

- English  French  Spanish  Arabic  Chinese  Russian
- Portuguese  German  Japanese
- Other:  Other Value

**17. Please provide three example terms, classes or concepts from your ontology or vocabulary.**



## Technical information

This section will provide us with more information about the technical aspects of your vocabulary/ontology.

**18. In which of the following languages or standards is the ontology or vocabulary available?\***

- OWL (Web Ontology Language)
- OBO-F (Open Biomedical Ontology Format)
- KIF (Knowledge Interchange Format)
- FLO (Faceted Lightweight Ontology)
- OIL (Ontology Inference Layer)
- RDF (Resource Description Framework)
- RDF-S (RDF Schema)
- DAML (DARPA Agent Markup Language)
- DAML + OIL
- SKOS (Simple Knowledge Organization System)
- OKBC (Open Knowledge Base Connectivity)

- OML (Ontology Markup Language)
- XOL (XML-Based Ontology Exchange Language)
- Frame-based
- Other:  Other Value

**19. What media types for distribution do you use?\***

- OWL/XML
- OBO Flat File
- OBO/XML
- plain text
- csv
- tsv
- spreadsheet (xls/xlsx)
- PDF
- HTML
- RDF/XML
- RDF/JSON
- RDF/TriG
- RDFa
- Notation3

- N-Quads
- N-Triples
- JSON-LD
- TBX/XML
- MDB
- turtle
- Other:  Other Value

**20. Is your ontology or vocabulary accessible through web services?**

- Yes  No  I don't know

If yes, please provide the

URL:

**20a. If so, which protocol(s) or architecture(s) do your web services use?**

- REST/RESTful (Representational State Transfer)
- SOAP (Simple Object Access Protocol)
- RPC (Remote Procedure Call)
- Other:  Other Value

**20b. Do your web services provide a public API (Application Programming Interface)?**

- Yes  No  I don't know

If yes, please provide the URL for the API  
documentation::

**21. Is your ontology or vocabulary accessible through a SPARQL Endpoint?**

Yes  No  I don't know

If yes, please provide the

URL:

**22. Would you like to receive further news about this questionnaire?\***

Yes  No, thanks

**If yes, please add your e-mail and we will contact you.**