



## **The Plant Phenology Ontology: A new informatics resource for large-scale integration of plant phenology data**

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Plant phenology — the timing of plant life-cycle events, such as flowering or leafing out — plays a fundamental role in the functioning of terrestrial ecosystems, including human agricultural systems. Because plant phenology is often linked with climatic variables, there is widespread interest in developing a deeper understanding of global plant phenology patterns and trends. Although phenology data from around the world are currently available, truly global analyses of plant phenology have so far been difficult because the organizations producing large-scale phenology data are using non-standardized terminologies and metrics during data collection and data processing. To address this problem, we have developed the Plant Phenology Ontology (PPO). The PPO provides the standardized vocabulary and semantic framework that is needed for large-scale integration of heterogeneous plant phenology data. The PPO was designed to be applicable to (nearly) all gymnosperms and angiosperms, suitable for both single plants and populations of plants, compatible with the data and data collection methods of existing national or regional monitoring program in the USA and Europe, and interoperable with existing OBO Foundry library ontologies, especially the Plant Ontology and the Biological Collections Ontology. Here, we more fully describe the PPO, and we also report preliminary results of using the PPO and a new data processing pipeline to build a large dataset of phenology information from North America and Europe. We close by discussing future Plant Phenology Ontology efforts, along with the social and technical tools for further developing global in-situ phenology products, including phenology sensor data.