

The future of field trials in Europe: establishing a network beyond boundaries

Forum Paper of the DFG-Senate Commission on Agroecosystem Research and Science Europe

Harmut Stützel^A, Nicolas Brüggemann^B, Dirk Inzé^C, 2016. Trends in Plant Science 21, 92-95.

<http://dx.doi.org/10.1016/j.tplants.2015.12.003>

^A Leibniz Universität Hannover, ^B Forschungszentrum Jülich, ^C Ghent University, Belgium

Summary

Field trials sites like experimental stations or experimental fields are essential research infrastructures for environmentally oriented agricultural sciences studying the interactions between cropping systems and the environment, and for plant sciences aiming to learn about the behavior of genetic material in natural environments.

A closer look at the **research topics** investigated at field trial sites demonstrates their irreplaceability: questions related to crop productivity and quality [1], climate change effects on crops [2,3], nutrient fluxes in agro-ecosystems, resource efficiency, stress mitigation [4] or the properties of resilient cropping systems cannot be investigated in test tubes in the laboratory. Usually they imply the interactions between genotype, environment and management [5]. The investigation of these interactions requires, in addition to genotype variation, ranges of environmental factors for gradients and variation in agronomic management. As a consequence, future research in plant and agro-ecological science will increasingly depend on **large-scale** and **long-term** data obtained from scientific experiments under **real-world** conditions.

Usually field trial sites are run by single research institutions. Individual universities or even larger governmental research institutes do not have the resources for setting up and maintaining a set of field trial sites covering the relevant range of natural conditions and allowing for state-of-the-art monitoring and experimental variation of environmental factors like temperature, CO₂ and water. Such an infrastructure can realistically only be organized as **a network of field trial sites** provided with long-term funding. This network should be considered a genuine governmental, or, in a **European context**, inter-governmental task. Such a network would give the research community the necessary administrative and financial security for long-term activities.

A network structure would allow for a coordinated development of the individual sites with the necessary specialization and optimal resource allocation. Keeping technical equipment up to date would be easier in a network and methodological standards and quality assurance systems could be implemented. Most importantly, a network would make interdisciplinary collaboration easier, simply because the chances to find appropriate partners are higher in a larger community. Moreover, a common infrastructure would also create a big stimulus for research collaboration across Europe and would have a very pronounced effect on the 'translatability' of academic plant and soil research to more relevant field conditions. In the 21st century, developing plant and crop systems towards higher productivity and reduced environmental impact is clearly not only a national task; joining forces on a European level would tremendously speed up scientific progress. Setting up a **European Consortium for Open Field Experimentation** therefore seems to be overdue!

Starting with the current situation of dispersed trial sites, an institutional framework could be initiated as an umbrella, under which the use of the experimental facilities and their development are organized. This umbrella should **be a self-administrated organization** of the participating universities, research institutes, etc., and would be responsible for defining the modalities of cooperation, e.g. the rules for use of experimental facilities, experimental standards, quality control, data utilization and publication.

A European Consortium for Open Field Experimentation should be an organization with high standards and sufficient resources to make it attractive for existing field experiment stations to become part of the consortium, and to enable it to be much more than just a provider for research infrastructure: it could be the forum for addressing the big themes of plant biological and agro-ecological research in Europe. To meet these challenges, the European Consortium for Open Field Experimentation should also be a platform for **interdisciplinary research** where scientists from very different disciplines join forces to tackle the grand challenge of providing sufficient and healthy food with a minimal impact on the environment in the next decades, when the effect of climate change will be substantial.

Tightly connected with interdisciplinary, large-scale research is the use of research data. With the high expenditures in open field research, data are valuable and should be utilized efficiently by sharing them widely. Well-described, quality-controlled data sets should be made available to the scientific community in an effective **data infrastructure**. To create an incentive for researchers to share their data sets, quality-controlled data sets should be made citable. Providing the necessary data infrastructure would also be a task for a European Consortium for Open Field Experimentation. The EU ESFRI bioinformatics infrastructure (<https://www.elixir-europe.org/>) also could be involved in supporting this activity.

We are convinced that the time is mature for an initiative as outlined above. A survey held among 30 experimental stations in Germany [6] clearly showed a **great willingness to collaborate** more intensely. Because a big bureaucratic monster is certainly not attractive, a network structure with clear rules, a high degree of transparency and a fair allocation of financial resources would be highly desirable, and regional substructures could help to minimize administrative costs.

Infrastructures for field trials including data management are a necessary prerequisite of research in plant science and agro-ecology. Setting up a common organization across Europe by an intelligent network of existing structures, simultaneously creating a best practice and quality control system, and an accessible data repository would be a major step forward in fostering a truly interdisciplinary European research arena to meet the challenges towards food production, bio-economy and sustainability of the next decades.

We propose the establishment of a European Consortium for Open Field Experimentation that allows for easy access of European plant and soil scientists to experimental field stations that cover all major climatological regions. Coordination and quality control of data extraction and management systems will greatly impact our ability to cope with grand challenges such as climate change.

References

1. Rozbicki, J. *et al.* (2015) Influence of the cultivar, environment and management on the grain yield and bread-making quality in winter wheat. *J. Cereal Sci.* 61, 126–132
2. Tao, F. *et al.* (2014) Responses of wheat growth and yield to climate change in different climate zones of China, 1981–2009. *Agric. For. Meteorol.* 189–190, 91–104
3. Sommer, R. *et al.* (2013) Impact of climate change on wheat productivity in Central Asia. *Agric. Ecosyst. Environ.* 178, 78–99
4. Chenu, K. *et al.* (2011) Environment characterization as an aid to wheat improvement: interpreting genotype–environment interactions by modelling water-deficit patterns in North-Eastern Australia. *J. Exp. Bot.* 62, 1743–1755
5. Hatfield, J.L. and Walthall, C.L. (2015) Meeting global food needs: realizing the potential via genetics × environment × management interactions. *Agron. J.* 107, 1215–1226
6. Stützel, H. *et al.* (2014) Feldversuchsinfrastrukturen – Status quo und Perspektiven. Positionspapier der DFG Senatskommission für Agrarökosystemforschung. *Journal für Kulturpflanzen* 66, 237–240