



European Plant Science Organisation
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White Paper

Horticulture Research in Europe – to 2020 and beyond

Horticulture makes a major positive contribution to modern European society in rural and urban areas, through sustainable food production, a greener environment and a healthier population. The total production value of horticultural crops in the EU for 2009 was over \$100 billion.

The ultimate beneficiary of research and development for sustainable and economically viable production techniques is the consumer who demands safe, reliable, high quality products. To this end we propose **five strategic aims as priority areas for research in Horticulture at European and national levels:** (i) Maximising *product quality*, (ii) *Improving integrated systems* with minimal inputs and waste, (iii) Supporting *Innovative approaches* to production and use of horticultural products, (iv) Providing the *genetic resource base* to breed improved crop cultivars, (v) Understanding the potential benefits and limitations of *Urban Horticulture*.

In addition, a much **closer cooperation of researchers, industry and policy makers is needed** using a multi-actor approach along the entire value chain to develop strategies for maximising the economic and societal benefits from Horticulture in the medium to long term. This should include: (i) *Establish Operational Groups* at regional level), (ii) support *Technology Platforms*, (iii) *Better coordinated horticultural research initiatives across Europe*, and (iv) Identify how European Horticulture can *play a role in developing countries*.

Horticulture: background and significance.

Horticulture makes a major positive contribution to modern European society. It is important in both rural and urban areas and contributes to sustainable food production, a greener environment and a healthier population.

Horticulture can be defined as an intensive branch of agriculture concerned with high value fruit and vegetable crops that are used by people as part of their diet, with herbs and spices and functional foods, with plants for medicinal use and ornamental species used for aesthetic purposes. It is considered as distinct from the production of arable or broad acre crops such as cereals and oil seeds, which are grown and traded in large quantities. Horticultural products are diverse, and play a major role in modern society and economies. Fresh horticultural products are an important component of traditional diets but are also central to healthy diets of modern urban populations. They are considered as functional foods, due to their high levels of a range of valuable nutritional compounds and consequently form part of special high-value diets for infants and the elderly. They also form the basis of a wide array of processed or partially processed products. Innovative companies reinvent traditional species or preparations as innovative products using fresh fruits and vegetables in fast foods and components of ready meals. Ornamental plants have high cultural value for humans as indoor and garden decoration, settings for leisure

activity and through urban greenery as an important part of the quality of life in towns and around cities.

Horticulture is a highly significant economic sector.

Horticulture has a large share in the total agricultural production value in all European countries. The total production value of horticultural crops in the EU for 2009 was over \$100 billion, compared with about \$40 billion for cereals (FAO statistics) and this value difference increases through the supply chain to retail. Protected cultivation has an increasing economic production value in the agricultural sector, e.g. in The Netherlands almost 40% of the national agricultural production value is created by protected cultivation that only occupies 7% of the total agricultural area.

Competitive advantage in Horticulture is a heavily linked to research capability and translation.

In addition Horticulture is an important employment sector in both urban and rural areas, providing alternative employment where opportunities for local people may be limited. Horticultural products and specialties can achieve good market prices but are in direct competition both within EU and outside Europe. Horticultural production is in most cases not supported by EU subsidies.

Horticultural products usually have a much higher per unit value than arable crops grown in less intensive systems per unit of product.

Horticultural products often require a high level of management in their production and subsequent use. Horticulture depends on cropping systems that are intensive i.e. require investment, labour, other inputs such as energy, water and nutrients; above all it is a knowledge and intensive sector deploying increasingly sophisticated management practices for protecting horticultural fresh products from pests and diseases. Horticultural farms tend to use smaller units of high quality land than other types of agriculture and have generally a high level of innovation. A significant amount of Horticulture takes place under protected cultivation where climate management, designed substrates, precise fertigation in closed circuits and the use of integrated pest management strategies are the rule, so that environmental impact can be controlled and the use of resources optimized. Inputs such as energy, water, nutrients and chemicals are used highly effectively in protected cropping systems.

The European horticultural industry, dominated by small and medium sized enterprises, has not been seen as a priority for coordinated or strategic research.

In spite of this background, Horticulture is largely overlooked in public and policy discussions about research support for agricultural production, food security and societal health. The agricultural industry, the bioeconomy and genetic research have focused on a few agricultural staple crops. Similarly, agro-environmental research has focused on the few agricultural crops that now dominate landscapes and food plates. Horticultural plants have been neglected both in biological and in applied research, and horticultural research across Europe is fragmented and disappearing.

Europeans need and want healthy food and green areas, but agricultural research portfolios are still concentrated on conventional issues such as biomass for energy, biorefineries or breeding of high yielding cereals. Since horticultural cropping systems are diverse and the common use of many different species and cultivars favours preservation of genetic resources and biodiversity.

Towards a European Research Agenda

The grand challenges facing the increasing world population and its supply with healthy food, will have a similar impact in the horticultural arena as in other areas of agriculture both inside and outside Europe, particularly as we enter a period of increasingly rapid climate change. *Safe, reliable and high quality production that secures sustainable intensification* poses common challenges to open field and protected production, and

much of the underpinning fundamental knowledge from model systems will be of generic relevance e.g. genetics, physiology, pest and disease resistance, flowering, seed biology, photosynthesis and stress tolerance. However, the diversity of products, the focus on fresh with particularly high quality standards and partially processed foods, different scales of production and the dynamic intensive and specialized production technology require *continuous innovation supported by explicit recognition*. Horticulture can contribute to society even more than today with coordinated research and development focused on Horticulture specifics.

Priority areas for research in Horticulture

The ultimate beneficiary of research and development activities for supporting feasible and economically viable production techniques should be the consumer who demands safe, reliable, high quality products. To achieve this we propose five strategic aims

1. Maximising *product quality*: Consumers require products that have high quality standards, with quality being demonstrated in a number of ways.
 - a. *High plant health status*. This will include the provision of planting material with high health status as well as the sustainable management of pests and diseases in production systems (e.g. integrated pest management).
 - b. *High postharvest performance*. There is a need for horticultural products that have good shelf life both before and after retail in order to maintain (nutritional) quality and sensory qualities and to minimize waste. It is essential that traits related to postharvest behavior are taken into consideration from the early steps of new crop design. Although not exclusive to horticultural food products, this area is of particular importance for fresh fruits and vegetables. For ornamentals, this is also highly important and has distinct challenges from food products.
 - c. *High human health value*, both *nutritional* (food) and *well-being* (ornamentals and urban green).
2. *Improving integrated systems* from farm to consumer for production with minimal resource inputs and waste.
 - a. Increasing the *efficient use of energy* and the use of *sustainable energy* sources
 - b. Maintaining healthy and *sustainable soil systems* and *efficient use of water and fertilisers*
 - c. Managing biodiversity to prevent or combat new *invasive pests and diseases* through agro-ecological approaches.
 - d. Crop management and intervention for predictable maturity and harvesting regimes to *minimize waste* in the production phase.
 - e. Developing intelligent production automation with the aim of facilitating an *efficient use of labour*.
 - f. *Developing integrated value chains* in order to ensure quality and reduce waste
 - g. Anticipating and adapting to the *impacts of climate change* through management practice and the development of environmentally robust varieties.
3. Supporting *Innovative approaches* to production and use of horticultural products.
 - a. Maximising *the contribution of fruits and vegetables to healthy and balanced nutrition*, including efforts to maximise the diversity of diets
 - b. *Development of new products* such as semi-processed and health-related foods.
 - c. Developing horticultural systems as contained factories for non-food products including pharmaceuticals and industrial cofactors
4. Providing the *genetic resource base* to support the breeding of improved crop cultivars to deliver the above objectives

- a. *Maintaining genetic resource collections* of plants and beneficial microbes to prevent erosion of the genetic base for future crop improvement.
- b. *Screening* genetic resource collections for desirable traits e.g. pest and disease resistance, stress tolerance, nutritional factors.
- c. Using modern high throughput methods for *genetic and phenotypic characterization* to enable the exploitation of the valuable diversity in form and properties captured within the resource collections.
- d. *Development of pre-breeding material* incorporating novel desirable traits to facilitate prompt uptake by the breeding industry

5. Understanding the potential benefits and limitations of *urban Horticulture*. There is considerable and growing interest in this topic, which will require the integration of many disciplines including Horticulture, social sciences, economics, planning and logistics. Topics could include:

- a. Integrating production and amenity Horticulture in urban and surrounding environments.
- b. Developing models of production that are resource-efficient and maintain consumer confidence.
- c. Understanding the role of local food production in Food Smart Cities.

We propose that specific future research and development initiatives in European Crop Production should address the evolving knowledge and innovation demand of Horticulture to reflect the multifaceted societal benefits represented by horticultural crops, products and the related sectors.

In addition to identifying research priorities, it is important that *researchers, industry and policy makers work closely* together using a multi-actor approach along the entire value chain to develop strategies for maximising the economic and societal benefits from Horticulture in the medium to long term¹. Approaches could include

- *Establish Operational Groups* (regional level) of actors involved with innovation in Horticulture to support knowledge exchange and the essential involvement of stakeholders.
- Identify where *Technology Platforms* can make a contribution to problem identification and problem solving strategies addressed by research and development in Horticulture
- *Better coordinated horticultural research initiatives across EU members* to address the particularly challenging interdisciplinary research and development environment of the sector
- Identify how European Horticulture can *play a role in developing countries* to develop their economy, improve their health and prosperity. Develop networks with stakeholders from all sections of the supply chain to understand where plant science can best add value and solve specific challenges

Ultimately, stakeholder groups at national and international level need to improve collaboration and directed interaction with research policy makers to ensure that the importance and potential of Horticulture is understood and promoted, and that Horticulture is better integrated into future Framework programmes.

¹ An example of how this has been successfully achieved for the fruit and vegetable sectors is through the European Fruit Research Institutes Network (EUFRI; www.eufrin.org) developing strategic documents; a White Paper (EUFRI Outlook) and a Strategic Innovation and Research Agenda document (SIRA) document that have been endorsed by relevant European stakeholders, including AREFLH (www.areflh.org) and Freshfel (www.freshfel.org). These documents could provide a model for all horticultural sectors.

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Useful links

EPSO Horticulture Working Group: <http://www.epsoweb.org/horticulture-wogr>
EPSO Horticulture Workshop 2013: <http://www.epsoweb.org/horticultural-workshop-autumn-2013-berlin-de>
EPSO communications: www.epsoweb.org/epsos-communications
EPSO member institutes and universities: www.epsoweb.org/about/members.htm
EPSO representatives: www.epsoweb.org/about/representatives.htm

EUFRIN Positioning Paper: The role of the European Fruit Sector in Europe in 2030,
EUFRIN Vision (EUFRIN Outlook): The role of the European Fruit Sector in Europe in 2030,
SIRA: Strategic innovation and research agenda for the fruit and vegetable sector; <http://www.eufrin.org/strategic-documents/>

About EPSO

EPSO, the European Plant Science Organisation, is an independent academic organisation that represents more than 227 research institutes, departments and universities from 31 countries in Europe and beyond. EPSO's mission is to improve the impact and visibility of plant science in Europe. www.epsoweb.org