# The Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture, Rehovot Campus

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# Plant & Environmental Sciences, The Alexander Silberman Institute of Life Sciences, Givat Ram Campus

**THE HEBREW UNIVERSITY OF JERUSALEM**

**Report of the Review Committee**

**July 2008**

**Presented to Prof. Haim D. Rabinowitch, Rector**

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***REVIEW COMMITTEE***
***The Robert H. Institute of Plant Sciences & Genetics in Agriculture, Rehovot Campus***
***Plant & Enviromental Sciences, The Alexander Silberman Institute of Life Sciences, Givat Ram Campus***

## Executive Summary - **Thursday, May 29, 2008**

The Hebrew University of Jerusalem (HUJ) established a Review Committee on Plant Sciences consisting of five scientists from outside Israel, who convened from May 25-29, 2008. They were provided excellent, albeit short opportunities to meet scientists and to tour facilities at two sites: The RH Smith Institute of Plant Sciences and Genetics in Agriculture at Rehovot (to be referred to herein as the HUR) and components of the Givat Ram campus' Alexander Silberman Institute of Life Sciences that are involved in research and teaching in areas directly related to plant sciences (to be referred to herein as HULS). It should be noted that the HULS visits included but were not restricted to the Department of Plant and Environmental Science; an overview of other activities in related areas of photoautotrophic organisms and ecological studies were included. At the start of the visit, HUJ President Menachem Magidor, Rector Haim Rabinowitch, and Professors Miri Gur-Ayre and Eli Friedman transmitted the purpose of the review directly to the Review Committee. They asked for an evaluation of the new organizational structure of plant sciences, definition of where HUJ has competitive advantage and opportunities for enhancement in this scientific arena.

The HUJ administration was very cognizant of the importance and broad significance of plant science as a component of both fundamental biology and mission-oriented (Agricultural/Ecological/Environmental) research. It was noted that within the Life Sciences, research on plants have unique specialties such as photosynthesis and chloroplast development, but also provides overarching and pioneering research that opens up new conceptual areas in biology (gene silencing, RNAi, epigenetics to name a few). The administration noted that fundamental information arising from plant biology is centrally important for understanding and responding to many aspects of global science, including sustainable responses to increasing demands for food, biological responses to climate change, preventative medicine via nutrition, and biodiversity preservation during a period of population expansion and global economic improvement. This information by the HUJ administration provided a foundation for initiating the review.

The first portion of the review focused on HUR, which in a component of the Faculty of Agriculture – the only Agricultural faculty in Israel. The RH Smith Institute (HUR) was created as an organizational unit in 2000 by merging three departments. A primary justification for the administrative change, as defined by the HUJ leadership mentioned above, was to facilitate a transition from traditional crop-specific research and teaching programs into disciplinary sciences. The functioning of the Institute is also being used to guide for subsequent reorganizations among other components in the Faculty of Agriculture. The second portion of the review was held on the Givat Ram campus of the university, with an emphasis on the Department of Plant and Environmental Sciences, and their interaction with other departments housing individuals with directly related interests to plant sciences. The review committee divided their evaluation into characterization of factors internal or external to the units under review. Internal environmental factors were divided into Strengths and Weaknesses; external factors into Opportunities and Threats. The consensus summary of

the committee's finding is provided in a SWOT (http://en.wikipedia.org/wiki/SWOT_analysis) analysis table in the following section of this report. As expected, weaknesses were often found to be the flip side of strengths. A primary example is the fact that, overall, individual faculty members of the HUJ are outstanding leaders in their fields, with superb groups of students (a strength). At the same time, strong individual research groups do not appear to readily form interdisciplinary teams (a weakness, since many of the most exciting current advancements in the life sciences are multidisciplinary, as is related translational research). In other instances, weaknesses were not balanced. For example, in the view of this review committee, there was unrealistic optimism/hope about capturing more faculty positions and restoring lost technician/support lines of funding in the strategic planning process. This was especially obvious in HUR, which was not able to articulate a plan for the future that factored in historical and continuing decline in state budgets to the university, and declining importance of Agriculture to the GDP of Israel.

External factors were characterized to identify forces outside of the control of units under review. These were broken into Opportunities and Threats, which were sometimes linked. For example, the fact that there is a large pool of highly skilled Israelis in-country and abroad (some of whom strongly desire to return to Israel) provides an excellent talent pool from which to recruit new faculty (an opportunity). However, there is increasing competition (a threat) for these individuals both internally (such as the HUJ Medical School, or other Israel universities and companies) and externally (such as foreign universities with highly competitive startup packages, or high technology companies abroad). We have attempted to evaluate these factors as we discuss means to enhance HUJ's competitive advantages. For example, since the priorities for selection of new Frameworks for grant funding in the European Union – which are increasingly a major source of research funds for HUJ – are not controlled by Israel, protection from the threat of policy changes must be factored into HUJ recruitment and structure. It is this committee's opinion that this threat can best be diminished by emphasizing disciplinary sciences with strong support for modern instrumentation, and implementation of interdisciplinary teams of researchers who can maintain individual laboratory continuity while also competing in new conceptual frameworks.

The review committee utilized a SWOT matrix analysis to identify best fits between opportunities and strengths. We have also used the external threat analysis to suggest ways to minimize their impact. Some of our suggestions are overarching between both HUR and HULS, and some are specific to location. We have prepared a list of recommendations that fall into four categories – Organization, Curriculum, Research, and Marketing. These are elaborated in Section 7 of the report. In overview, our recommendations emphasize: 1.) there is no need to reorganize either HUR or HULS to improve plant sciences, although leadership practices and student guidance within those units can be enhanced; 2.) curriculum reform should be used to respond to emerging trends in global plant sciences, but also to reflect and drive evolution of existing programs; 3.) research issues of most critical importance are related to equipment procurement and maintenance to strengthen existing programs, and to allow recruitment of the next generation of research stars; and 4.) marketing (external image enhancement) which is needed to augment the current high profile image of individuals within HUJ by also improving the combined image of plant programs to position them to capture new funding resources available from foundations and philanthropic sources.

The committee thanks the HUJ staff who has provided excellent support to our review efforts, and in particular to Frances Neumark in the office of the HUJ Rector.

# COMMITEE'S REPORT

**Report of the International Review Committee on**
**The Robert H. Institute of Plant Sciences and Genetics in Agriculture, Rehovot**
**Plant & Environmental Sciences, The Alexander Silberman Institute of Life Sciences, Givat Ram**

This review committee recognizes that our visit to HUJ has allowed us to only capture a "snapshot in time." However, we have tried to capture input to place our observations into context of a rapidly changing environment for university activities that are unique to Israel (3 strikes and one war in the last three years, for example) and in the global academic community (with constrained to declining public funding for research/teaching in the U.S. and Europe, which interact strongly with HUJ).

The committee members enhanced their personal understanding of the HUJ educational system during this review. We applaud the historical and continuing practice of recruiting faculty with a focus on outstanding research accomplishment as the primary selection tool, followed by a decision to make offers related to areas of science and teaching needs. However, in this process we emphasize in the sections below that disciplinary research in plant sciences must be the primary criteria at HUR, and that a goal of expanding the community of biologists who participate in plant-related studies would have a very strong positive impact on the quality and impact of academic programs across the breadth of the Alexander Silberman Institute of Life Sciences of HUJ.

As a tool to increase the efficiency of our review process, we have adopted a process common in the business community – SWOT analysis. This is commonly used in strategic planning, but also is of value in the creative generation of possible strategies (in our case, a set of recommendations). We suggest that our SWOT analysis could be used as a starting point for further refinement by the plant science community of the HUJ, in an effort to enhance communication across the plant science community of HUR and HULS, and to identify opportunities for improvement for student training and interdisciplinary research. A "plant sciences retreat" to bring together the combined community of sciences, with input from HUJ administration, could be useful.


The aim of any SWOT analysis is to identify the key internal and external factors that are important to achieving the objective – in this case, a planning process to identify and prioritize changes that may enhance the impact and effectiveness of HUJ plant science programs. We have tried to factor in external elements such as technological change, political support of universities in Israel, as well as changing business environment that will provide employment for the majority of the HUJ graduates. We recognize that the multiple entries in our SWOT matrix are not of equal importance in creating or implementing strategic action. We have, therefore provided a more extensive discussion of each component of the

SWAT analysis in the following sections, to provide a basis for our “moment in time” analysis.

The committee’s SWOT analysis is summarized on the following table:

## **STRENGTHS** (Internal)

### 1) What does the unit do well?

- Both locations attract top students and retain them
- Both recruit top faculty
- Both attract a high level of funding

**Rehovot**

- Offers breadth of scientific areas
-Moved significantly into Molecular Science
- Interacts well with Volcanic Inst. for mutual benefit

**Givat Ram**

- Excellence in selected areas of plant science
- Strong ties to other science disciplines

### 2) What is the unit's reputation?

- HUR and HULS have very strong reputations
- Individuals at both locations are highly recognized in Israel and abroad

### 3) Does the unit have a clear strategic direction?

**Rehovot**

- Individuals have strong visions

**Givat Ram**

- Plant and Environmental Sciences Dept. has a vision

### 4) What aspect of the unit's culture enhances its success?

- Both locations value and reward individual initiative and academic freedom
- Both locations have pride in the Institution
- Both have attractive campus surroundings

**Rehovot**

- Strong ability to cross-feed disciplines, including ability to interact with Volcani programs

**Givat Ram**

- Complementary disciplines (physics, chemistry, computer science) are embraced readily

## **WEAKNESSES** (Internal)

### 1) What could be improved in the unit?

**Rehovot**

- Outside visibility
- Encouraging consensus building
- Enhancing student Collegiality
- Curriculum redesign
- Industry engagement at Institute level
- Strategy development for obtaining faculty consensus

**Givat Ram**

- Improve breadth of scientific areas under study in plant-related science
- Improve interactions within Institute of individuals with plant expertise

### 2) What does the unit do poorly?

**Rehovot**

- Organized support for student mentoring/ advising/placement
- Priority setting
- Consensus building among faculty

**Givat Ram**

- Infrastructure maintenance
- Establishment of "sunset provisions" for shared facilities

### 3) Is the unit unable to finance needed technology?

**Rehovot**

- Uneven across disciplines

**Givat Ram**

- Falling behind US & Europe

### 4) Is the unit constrained in flexible resources?

**Rehovot**

- Institutional rules severely constrain resource reallocation

**Givat Ram**

- Institutional rules severely constrain resource reallocation

| **OPPORTUNITIES** (External) | | **THREATS** (External) | |
|---|---|---|---|
| **Rehovot** | **Givat Ram** | **Rehovot** | **Givat Ram** |
| **1) What favorable circumstances does the unit face?** | | **1) What could be improved in the unit?** | |
| - External pool of outstanding Israelis for recruitment into new faculty positions at both locations | | - Overall adjustment to declining HUJ budgets, in face of increasing operating costs of modern science, at both locations | |
| - Global enhanced demand for food and fiber<br>- Global enhanced demand for trained personnel in Agricultural Sciences | - Expanding sources of funding for start-up companies which will complement discovery science in the Institute | - Faster adaptation to dramatically changing agricultural industry in Israel<br>- Pursuit of new sources of grant support | - Stronger group strategy to win funding for interdisciplinary or translational research<br>- A robust strategy to replace aging equipment |
| **2) What are the exciting trends in Plant/Agricultural Science? (Is the Institute positioned to take on these trends?)** | | **2) What is the "competition" doing (including external to Israel)?** | |
| - Systems Biology and Genomics (Institutes are positioned to participate) | | - Competition is gaining expertise in non-traditional funding, and related "marketing" of strengths | |
| - Emergence of environmental issues (good response by Institute)<br>- Management of non-agricultural land (emerging response by Institute)<br>- Rapidly advancing molecular techniques (good initial response by Institute)<br>- Rapidly expanding demands for biotechnology applications (good initial response by Institute) | - Multidisciplinary research is increasingly having major impact (Institute is well positioned to participate) | - Schools of Agriculture and Environment are moving more rapidly into disciplinary sciences related to Agriculture (less crop specific)<br>- Bioinformatics is being used extensively in Agriculture-related sciences<br>- Nutraceutical (value-added) research is rapidly evolving in other locations | - Competition has expertise in team building for inter-disciplinary research |
| **3) Is the Institute entering new areas?** | | **3) Are changes in the industry/Academia challenging programs?** | |
| - Institute is a leader in marker- | - Structural biology | - Agricultural production of traditional | - Increased emphasis on |

| | | | |
|---|---|---|---|
| assisted breeding<br><br>- Center of excellence for tomato & pepper improvement<br><br>- Building expertise in model crop molecular technologies<br>- Good ties between molecular technology and field evaluation<br>- Inst. researchers well connected with international collaborators | established but limited<br><br>- Quantitative biology/ecology is strong<br><br>- Modest entry into genomics programs<br>- Biodiversity explorations, strong in selected areas (microbes)<br>- Translation of biology, emerging in selected areas (Example: biosensors) | Israeli export crops are moving to countries with low production costs<br>- Non-traditional land use policies demand new management skills and technology<br><br>- Israeli agricultural industry is becoming technologically advanced. | interdisciplinary research in biological programs<br>- Increased emphasis on translational research at major institutions |
| **4) Is the Institute advanced in technology?** | | **4) What funding trends threaten the Institute's position?** | |
| - Inst. has advanced technology in specific areas<br><br>- Recruited young leaders in molecular biology<br><br>- Emerging programs of excellence in biodiversity/crop evolution<br><br>- Participating in modern instrumentation utilization (especially related to chemistry)<br>- State-of-the-art Phytotron | - Recruited young leaders with technology skills in molecular biology<br><br>- Leadership in some areas of photobiology research<br><br>- Strong interaction between field and lab in cyanobacterial equipment | - Diminishing importance of Israeli agriculture threatens state support of agricultural science.<br><br>- Global environmental issues may shift funding priorities<br><br>- Increased funding for value-added and nutraceutical research is not well met at institute<br><br>- Increased funding demands of medical-related research may take priority within Israel | - Increased funding demands of "competition" within HUJ may take priority<br>- Priority setting by EU may re-focus funding opportunities |

## Strengths

Committee opinions incorporated into the SWOT analysis table shown above warrant further explanation. Overall, the committee enthusiastically agrees that the HUR and HULS are excellent components of a great university. The staff includes outstanding faculty who are internationally recognized for their leadership in their respective fields of expertise. The students we met were highly motivated and of top quality. Both institutes have moved significantly into Molecular Sciences and are developing top-notch biological research that has been instrumental in attracting extramural support and a high level of research funding. The high quality of the research and the reputation of the institutes serve to attract the most qualified young scientists and the level of the new appointees is superb. Members of both institutes displayed high levels of individual initiative and academic freedom. During the discussions with this committee the high scientific standards and the pride of each researcher with the Hebrew University of Jerusalem was evident.

The presence of plant science faculty among the Alexander Silberman Institute of Life Sciences is a key element adding to the strength and breadth of the Institute. Not only do they provide the significant contribution of plant sciences to overall Biology research and education in the Hebrew University, but they also offer outstanding contributions to different disciplines such as Population Biology, Interaction with the Environmental, Photobiology, Microbial and Landscape Ecology, Development, Genetics, etc. The location of HULS in the Givat Ram campus allows interaction of professors and students of the Institute of Life Sciences with colleagues of different disciplines (Earth Sciences, Physics, Chemistry, etc.), to potentiate the development of top-notch multidisciplinary approaches in Modern Biology.

The Robert H. Smith Institute of Plants Sciences and Genetics in Agriculture in the Faculty of Agriculture at Rehovot represents a multidisciplinary effort in Plant Sciences research, combining basic and applied research in crop sciences. The Institute represents an organizational effort by the University towards the development of discipline-based research and education dealing with the fast new developments in Plant Sciences. The Institute brings together different aspects of Physiology, Biochemistry, Ecology, Genetics, Breeding, and Genomics of model plants and important crops aimed at providing solutions and opportunities to the problems associated by a rapidly changing agricultural production in Israel. HUR maintains an active and vibrant interaction with other Israeli centers of education and research. Through the interaction with the Volcani Center, HUR researchers are developing research interactions with immediate agricultural-based applications. The awarding of adjunct professorships to the best Volcani Center researchers provides the HUR with a rich source of teaching capabilities and also provides a means for HUR graduate students to conduct research based at the Center. The proximity to the Weizmann Institute allows interactions among graduate students and researchers and the common use of equipment.

The review committee was impressed with the interactive practice in both Institutes and the sharing of equipment and facilities. The interdisciplinary equipment facility at Rehovot is an example of a resource in chemical/biochemical analysis comparable to the best in the world.

Overall, the Review Committee in Plant Sciences is very impressed with the quality and quantity of the Plant Sciences research and education at the Hebrew University. The research accomplishments and the high quality of their publications have contributed to the high scientific reputation of the researchers at both HUR and HULS. This extensive quality and expertise has been instrumental in the development of an outstanding educational platform

that nucleates the best biology students of the country and warrants the formation of the top-notch Israeli plant science researchers of the future.

## Weaknesses

While the committee was highly impressed with the strength of individual research groups at both HUR and HULS, there were also factors which were regarded as weaknesses and thus limit the overall effectiveness of the plant sciences on both campuses. One significant deficiency of the plant sciences in HUJ is the lack of integration of educational programs and research activities between HUR and HULS. In part, this stems from a lack of "corporate identity" in plant sciences. A result of this limitation is a diminished ability to develop internal consensus, and also limitation in projecting strength to external communities.

The committee spent significant time at HUR discussing consensus building. We found that multiple individuals expressed very strong opinions about their visions for the institute, for both teaching and research. But, these were generally not congruent, and revealed a generational divide. Senior faculty, especially Emeritus faculty members, stressed the need for continuity with the past (particularly with crop-specific research programs). In contrast many of the younger faculty appeared eager to adapt to new challenges and especially to disciplinary sciences. The committee was puzzled by the apparent lack of organized consensus development, and to learn that faculty meetings are held very infrequently. Most faculty members seem to perceive solutions for existing problems only in the context of increased funding from University resources – an unrealistic expectation in our view (based on administrative briefing). The committee heard little evidence of creative brainstorming by the faculty as a group to explore innovative new strategies for strengthening HUR.

Within HULS, scientists involved in plant research plant-related research are dispersed over three departments. We were provided with adequate justification for this organizational structure, and see no reason to suggest organizational changes in what currently exists. However, we note that an outcome of this organization is decreased efficiency in identifying overarching problems relating to plant sciences, which probably calls for increased intervention at the level of institute administration. This is particularly problematic in relation to infrastructure maintenance (discussed further below).

Since the committee consists of members from multiple sites outside of Israel, we used our combined backgrounds to assess the "image" of plant sciences at HUJ. We conclude that while individual scientists and their programs are highly regarded (see Strengths above), it is much more difficult for an external observer to perceive broad areas of plant science strength within HUJ. For example, we were very pleasantly surprised by the facilities and related programs in chemical/biochemical analysis that are in place at HUR. There is great potential for projecting a position of excellence in metabolomics and related studies of nutraceuticals (health-benefiting components of plants) to the external scientific community. We had similar feelings about the potential to emphasize crop evolution as well as biodiversity for combined programs at both locations. Our committee concludes that the lack of integration across plant programs, and a limited ability for coordinated decision-making, is limiting the impact of nascent multidisciplinary programs within HUJ. We regard this as a weakness, since many emerging funding programs (EU frame-work programs, institute level ERASMUS programs, or philanthropic funding) are directed to multidisciplinary, multi-investigator studies in "centers of excellence." While HUJ plant scientists easily have the combined

credentials to be recognized in this context, the potential for combined recognition is weakly implemented.

Among multiple issues raised during the review, one that appears to need full attention is curriculum redesign. Numerous individuals pointed out to us the difficulty in teaching all the courses currently listed (especially at HUR). In part, it appeared that some individuals justified the retention of untaught or "under-taught" courses as a justification for further faculty recruitment; this seems to us as unrealistic. In the view of the committee, HUR in particular is faced with major changes in Israeli agriculture and land use policies that necessitate corresponding changes in curriculum. We noted that the Institute faculty were aware of these needs, but stressed the need for additional financing as a solution. Without leadership, the faculty appears unable to arrive at innovative alternative solutions to create a modern curriculum. We were told that inflexible financial roles at the University level impede change, but did not hear creative ideas about working around such limitations. We noted that the course offerings for graduate students is strongly focused around individual research groups, which limits the breadth of educational opportunities. We conclude that the lack of a process to develop an improved curriculum to provide multidisciplinary training for HUJ students in the plant sciences will increasingly be a limitation in the future.

Within HULS, the curriculum components involving plant sciences operate within the framework of the life sciences institute. We found it surprising that plant sciences are not included in introductory biology courses, and conclude that it is a weakness. We do not see as being a sound philosophy to allow life sciences students to complete their studies without ever being exposed to any plant biology.

The committee also perceived a weakness related to student mentoring and availability of career advising and employment placement. It appears that these activities are left almost entirely to individual faculty members with little overarching support at the institute level. Based upon our experience at other universities, this is a weakness at the Hebrew University. (We should emphasize, however, that we did not hear complaints or concern from the students about these issues.)

During the review it became apparent that interactions with industry (in Israel or abroad) and with neighboring institutes within Israel is largely left to individual faculty initiatives. We found this particularly surprising at HUR, which has had a history of "outcome relevant" research. They did not have an industry advisory counsel, for example (which could also be useful in linking students to employment opportunities, internships, etc. as was mentioned in the preceding paragraph). In light of the present changes that are presently taking place in Israeli agriculture and biotechnology, we feel that an organized linking with the external community is a weakness. There would also be value in linking to advisory groups involving other Israeli institutions that are involved in related areas of agriculture education and research (such as colleges that are now offering programs in production agriculture), to gain more than antidotal information about curriculum offerings that may be redundant to traditional HUR offers; such information could aid in curriculum modernization efforts.

The biggest weakness recognized by the committee across both HUR and HULS was that of infrastructure maintenance. While HUR has been able to maintain excellent infrastructure in a few areas, the situation at HULS is becoming severely limited. With respect to its overall ability to finance state-of-the-art technology, it is our concern that HUJ is rapidly falling behind -- not only in comparison to the USA and Europe but also to emerging countries such

as China and Korea. In HULS the committee was shocked by the conditions of the plant growth facilities, much of which was a result of inadequate funding for maintenance, as well as placement of growth chambers in inappropriate facilities. While we were highly impressed by willingness of faculty at HULS to share the equipment that does exist, we must note that many pieces of critical equipment are already outdated or are becoming so. For example, even though HUJ researchers are leaders in photosynthesis research, some pieces of equipment such as spectrophotometers are 20-30 years old, and largely function only through the unselfish service of an emeritus faculty member. The nucleic acid facility at HULS presented a slightly different situation. While it is well organized with fine staff, it appeared to offer standard services that are now largely outsourced in other institutions. Rather than continuing as it is, it should be able to upgrade and provide cutting edge technology that truly reflects the term "genomics" in its facility title.

A weakness that was brought to our attention on several occasions relates to accounting rules at the university that are not sufficiently flexible. Examples given referred to resource allocation rigidly based on the number of faculty and number of courses, which made it difficult to transfer money/positions based on changing needs.

## Opportunities

HUJ is exceptionally well placed to attract and recruit excellent research scientists from around the world because of its reputation and tradition of scientific excellence, endeavor, and productivity in Plant Sciences. Moreover, the unique position and status in Israel of Agriculture, Food and Environmental Sciences (at HUR) and Life Sciences (in HULS) will continue to facilitate the recruitment of the best and most dynamic talent in appropriate fields of cutting edge research and teaching. There is a large pool of Israeli post-docs and senior researchers who would welcome the opportunity to join the HUJ. Moreover, both Institutes are well placed to exploit the increasing worldwide requirement for the highest quality graduates, MSc and post-doctoral workers, with a broad, interdisciplinary training in cutting-edge science and associated technologies.

Another opportunity relates to the recent re-emergence of global interest in plant sciences and agriculture as a result of soaring food prices and food shortages in poor countries. It is being recognized that the successes of the "green revolution" and related agricultural technologies in the 20th Century led to complacency by policy leaders who control investments in continued productivity advances around the world. There is also recognition of a paradox – the demand for greater food production must use agricultural systems that currently account for about 70% of global annual water withdrawals, and up to 95% in some developing countries. As a result, many people have to choose between water for growing food and water for public health and industrial development. If the world is to make significant gains in addressing emerging public health crises, agriculture must evolve in an environmentally-neutral and sustainable manner. Additionally, global climate change will certainly impact agriculture in many ways, and the prudent response to such change is to prepare to adapt. This can certainly be viewed in a positive light; we should anticipate a new paradigm in world agriculture – one that incorporates new plant-related technologies at a rapid pace, but also agriculture as an instrument for public health which is focused not only on the quantity of food it produces but the nutritional quality.

Research in plant sciences has taken many new directions in the last decade. There is greatly expanded interest in biofuels, especially from cellulosic sources or algae. There is a rapidly emerging industrial use of plant biotechnology for protein pharmaceutical production; it is relevant that companies in Israel are in the vanguard in this arena. There is strong interest in related areas of drug discovery and production of specialty chemicals. With respect to environmental issues and "quality of life," there will be important new calls for understanding plant biodiversity and its preservation while also supporting enhanced societal economic advancement. All of these areas of endeavor will require new research and educational programs. Plant sciences must be regarded as a "growth area" in the scientific disciplines, with a diverse array of opportunities for universities prepared to respond to the new challenges. Overall, HUR and HULS have the talent pools in their faculty to be leaders in the response to many of the emerging challenges.

There is strong evidence for the ability of HUJ faculty to respond to new opportunities. The publication records of individual faculty in plant sciences at HUJ bear testimony to their ability to enter and exploit new areas. Multiple publications in high citation-index journals demonstrate that the researchers are able to create or embrace emerging technologies and use them effectively to undertake cutting-edge research programs. HUJ plant scientists that excel in stress biology and photobiology are already in a position to capitalize on current funding trends in key areas such climate change, energy research, ecology and plant improvement. Structural biology is also established at HULS and has the potential and capacity for further development. Quantitative biology and ecology are very strong and have enormous potential for expansion for development into new areas, particularly in multidisciplinary teams. There is great potential for effective use of current capabilities in individual cell, organism and population genomics, in these and related areas such as conservation biology and biodiversity studies. In particular, the evaluation team noted the outstanding potential of the current research programs on molecular ecology of photosynthetic and non-photosynthetic micro-organisms, and separate activities in crop evolution. The evaluation team could readily see that HUJ plant scientists have world-leading programs in crop breeding using molecular approaches, such as marker-assisted selection, and are building disciplinary strength that will apply broadly to multiple crop species. Overall, plant sciences in HUJ are poised to become more broadly recognized by the global community as a center of excellence in translational biology, in which basic research discoveries and advances are translated not only into organism/plant, and crop improvements but are also exploited by agro-industry, biotechnology and innovative industrial applications.

We also recognize that there are significant opportunities for both HUR and HULS to exploit the outcomes of their research achievements in small start-up companies, housed either within the existing University facilities or in associated facilities. Given the exceptional record of Israel (and HUJ) for successful technology and knowledge transfer, the Institutes have increasing opportunities to generate additional income and prestige from the exploitation of new knowledge and novel scientific tools (e.g. biosensors), in addition to publications as outcomes of their research efforts.

Individual researchers have strong functional links with relevant local and national industries. The existing relationships with user groups and industries could easily be further developed and exploited by HUJ researchers working together to secure greater funds, provide new job opportunities for graduates and post-graduates and extend the influence of HUJ scientists on the economy of Israeli agriculture and potentially agricultural science policy in Israel.

The present organization of Plant Sciences within HUJ provides a means to respond to external opportunities by encouraging effective interactions between researchers, as well as enhancing the global visibility of Plant Sciences as a whole at HUJ. In particular, it allows for the exploitation of new funding opportunities in the global research market. (An example of a target would be a Marie Curie research and training site, which would be well funded and recognized within the European Union.) Effective consensus building and team-building to achieve a critical mass will ensure success in response to emerging opportunities. While the present buildings and equipment are sufficient to provide the research teams with their immediate needs, new teams will also justify significant opportunities for refurbishment and embracing new technological platforms in order to optimize chances for success.

## Threats

There are multiple external forces beyond the control of HUR and HULS that will influence their future, and pose significant challenges. The most significant is a continuing decline in state or central university funding – a trend that is also occurring in the US and Europe. The availability of these sources for funding support personnel, equipment and maintenance need to be replaced. Even if it will be possible to maintain the current state of the budget, it can be expected that employment and operational costs will still increase to support modern plant and agricultural sciences. Even for field research, costs will increase to match or lead the rapid changes in plant-related industries as they adopt sophisticated and expensive technologies. The plant sciences can also expect internal competition for resources within HUJ. Hi-tech expensive equipment and infrastructure are also necessary in other programs of the university, and the "plant/agriculture" community needs a coordinated plan to successfully compete. A lack of sufficient funds is already noticeable with regards to the maintainence or replacement of some pieces of large equipment.

External competition, especially in universities outside Israel, is moving rapidly into new areas of plant sciences such as systems biology, bioinformatics, energy-related research, and plant-made pharmaceuticals. One reason that this is more easily possible for competing institutions is that at other places scientists are able to secure more funds through sophisticated marketing strategies and through attracting non-traditional, novel funding sources. A necessity to compete for these funds is expertise in team building for interdisciplinary research projects. HUJ plant sciences currently appears to be at a disadvantage in creation of multidisciplinary teams and projecting their strengths to external communities.

Agricultural industry and demands for agricultural crops are rapidly changing in Israel. One reason for this is that production of traditionally strong Israeli export crops have been moved to countries with lower labor costs (and sometimes lower environmental protection costs). This change affects strongly the agricultural faculty at HUR. It is no longer wise to recruit a faculty member who would devote their career to crop-specific research; today it is necessary to find researchers with skills in disciplinary science who can apply their skills to multiple and changing problems. The students trained by HUJ plant sciences must also be prepared to join Israeli industry which is already technologically advanced and needs leaders with increased emphasis on interdisciplinary and translational research. In addition to dramatic changes in agricultural products and production technologies, there are emerging policy issues related to land use and environmental protection. The next generation of leaders who will develop non-traditional land use policies will require new management skills and

understanding of new technologies for ecological protection in the context of economic and industrial development – a complex set of issues!

Funding trends for plant-related research are in flux, and adaptation to new trends is essential. Plant scientists at HUR and HULS have been highly successful in competing for internal and external funds from a variety of funding agencies, including international agencies such as European Union or bilateral sources like BARD, GIF or MINERVA and others. However, global priorities (energy, environmental protection, etc.) may shift international funding areas. It is already noticeable that the priority setting of research programs within the EU restrains opportunities to obtain funding for plant science; not only are costs for modern plant science increasing, but there are also increased funding demands for medical research, which may get priority if plant science does not use a convincing marketing strategy. The diminishing importance which agriculture tends to play within the national economies of developed countries (including Israel), may lead to a decrease of funds allocated to agricultural and plant science with regards to national funding.

## Recommendations

### 1. Maintain the organizational structure of HUR and HULS

The committee considers the present organizational structure adequate and does not recommend reorganizations. HUR has a clear mandate of "outcome-relevant research", whereas the strength of HULS is in basic science. The separate department of plant science at HULS serves as a focal point, while the presence of plant-related scientists in other departments provides excellent opportunities for cross-fertilization between biological disciplines.

### 2. Enhance the university-wide interaction of plant scientists

Improved interaction between plant scientists at HUR and HULS will greatly help in integration of the superb research and educational activities at both Institutes. Moreover, a stronger interaction between the campuses will allow for the development of common research resources and also to the generation of new teaching initiatives for the benefit of the Plant Sciences graduate students. For example, the extensive expertise in computational biology and bioinformatics at Givat Ram would allow the development of intensive (perhaps one-day courses) for the benefit of students of both Givat Ram and Rehovot. On the other hand, the hands-on expertise in field biology, plant transformation, and chemical/biochemical analyses at Rehovot could provide important educational offerings for the benefit of the graduate students of both campuses. The HULS and HUR websites could be used much more effectively to enhance the visibility of the Institutes and the plant sciences of HUJ as a whole.

### 3. Enhance Faculty Consensus Building

As part of improving intercampus interaction, shared planning needs to be implemented. The committee recommends the organization of a HUJ plant science faculty retreat where the research and educational needs of the Institutes are thoroughly analyzed and discussed. The committee sees of great importance that the participation of the salaried faculty be emphasized. A goal should be to give young faculty a more prominent role in long term planning. At HUR, we urge a companion activity emphasizing consensus building among the plant science faculty to encourage a shared plan for future development of the Institute. Faculty meetings (every two months, at least) should facilitate the discussion of the Institute needs (infrastructural, resources, field, etc.). The organizational interaction among the Plant Sciences faculty at the Silberman Institute of Life Sciences should aim at improving the common facilities (emphasis be placed on the replacement of old equipment, repair of growth facilities, etc.). Because of the cross-departmental organization, we recommend increased participation by the Institute leadership in this process.

### 4. Improve Professional Development for Graduate Students

The review committee feels that professional development of graduate students can be enhanced. Current student advising appears to be solely the responsibility of individual faculty with whom the student does thesis research, which is supplemented by unofficial gathering of information from fellow graduate students. Career opportunity advising can be improved at the unit level. We recommend the creation of a mentoring system in which all students have a mentor whom they can approach when they need to choose courses, or if personal difficulties arise. The mentor for the MSc and Ph.D. student should be different from the immediate supervisor, so as to supplement the career advice the student obtains. The mentor should have a good overview of the choice of courses, and should know the career possibilities available for the different degrees. The mentor could also draw the attention of the students to possible industrial placements or possibilities to obtain credit points by

studying abroad through specific programs. We also see the need for a means for the students to share their research activities with faculty and other students to enhance the HUJ experience. A student "research day" (once a year, at least) should be organized by the graduate students. During this event, students will expose their work and results in the form of oral presentations and/or scientific posters in organized discussion sessions. The approval of the requirements for a graduate degree in the Institutes should be conditional on the participation of the graduate students in the Departmental seminars. (It should be noted that the graduate students at both Institutes did not identify the need of an increase breadth of knowledge as a necessity; our recommendation is based upon the committee's comparison of HUJ to other institutions.)

**5. Establish a Rigorous Process for Curriculum Overhaul**

The current course offerings in plant sciences are based more upon historical practice than upon a process that ensures updating of scientific content and optimal student education. Consideration needs to be given in relation to introducing novel teaching methods such as web-based learning, and strengthening discipline-based science offerings while mitigating the effect of the increased teaching load due to reduced staff. As indicated earlier, enhanced interactions between students of different research groups can be attained by mandatory attendance to courses and research seminars. New offerings should emphasize joint advanced courses that are accessible to students from both HUR and HULS.

**6. Establish an Industry Advisory Committee**

Particularily at HUR, but also involving HULS, there should be a more formal mechanism to ensure that constantly changing needs of Israeli industry are linked to academic programs of HUJ. The mandate of such a committee should include discussing the strategic needs of Israeli agriculture and related biotechnology industry, and to enhance networking between HUJ graduates and potential employers.

**7. Improve the "Marketing" of HUJ Plant Sciences to External Communities**

To achieve even greater success in the future, HUJ plant sciences should strive to increase its global profile and reputation outside Israel. Individual scientists have achieved considerable international recognition. However, plant sciences overall at HUJ has a relatively low profile. As the HUR and HULS faculty develop a consensus overarching vision of the scope of research and the global aims of the work undertaken as a group (see recommendation above), this needs to be translated into a public information statement. The HUJ vision should be placed on its website at the earliest opportunity to enhance the visibility of the plant sciences as a whole. The university's development officers should be brought in as part of this process, to aid in identification and communication with non-traditional funding sources that will increasingly be necessary to maintain HUJ excellence and vitality in the 21$^{st}$ century.

# APPENDICES

# APPENDIX A

## RESUMES OF COMMITTEE MEMBERS

1. Prof. Charles J. Arntzen, (Chair) Biodesign Institute at Arizona State University

2. Prof. Dorothea Bartels, University of Bonn

3. Dr. Eduardo Blumwald, University of California

4. Prof. Christine Foyer, University of Newcastle upon Tyne

5. Prof. Cris Kuhlemeier, Institute of Plant Sciences, Bern

## BIOGRAPHICAL SKETCH

| NAME | POSITION TITLE |
|---|---|
| Charles J. Arntzen, Ph.D. | Regent's Professor and Florence Ely Nelson Presidential Chair |

| INSTITUTION AND LOCATION | DEGREE | YEAR(s) | FIELD OF STUDY |
|---|---|---|---|
| University of Minnesota, Minneapolis, Minnesota | B.S. | 1965 | Plant Physiology |
| University of Minnesota, Minneapolis, Minnesota | M.S. | 1967 | Plant Physiology |
| Purdue University, Lafayette, Indiana | Ph.D. | 1970 | Cell Physiology |
| Charles F. Kettering, Lab, Yellow Spring, Ohio | Post-Doc. | 1969-70 | Photosynthesis |

**Professional Experience**

| | |
|---|---|
| 1969-80 | Assistant to Full Professor, Department of Botany, University of IL |
| 1973-74 | Research Scientist, Laboratoire de Photosynthese du CNRS, Gif-sur-Yvette, France |
| 1976-80 | Plant Physiologist, USDA/SEA, Urbana, IL |
| 1976 | NATO Scientist, Laboratoire de Photosynthese du CNRS, Gif-sur-Yvette, France |
| 1980-84 | Director, MSU-DOE Plant Research Laboratory, Michigan State University |
| 1981 | ANU Fellow, Australian National University, Canberra, Australia |
| 1983 | Visiting Scientist, Academia Sinica, Beijing, China |
| 1984-88 | Director, Plant Science and Microbiology, DuPont Central Research & Development Department, and Director, Biotechnology Research, DuPont Agricultural Products Division, Wilmington, DE |
| 1988-95 | Deputy Chancellor for Agriculture, Dean, College of Agriculture and Life Sciences, Director, Texas Agricultural Experiment Station, Texas A&M Univ., College Station, Texas; Professor, Dept. of Biochemistry and Biophysics; Director, Plant Biotechnology Program, Institute of Biosciences and Technology, Texas A&M Univ., Houston, TX |
| 1995-2000 | President and CEO, Boyce Thompson Institute for Plant Research, Inc. and Adjunct Professor, Cornell University |
| 2000-Present | Florence Ely Nelson Presidential Chair in Plant Biology and (since 2004) Regent's Professor, Arizona State Univ., Tempe, AZ |

**Honors and Awards**

| | |
|---|---|
| 1979 | Charles Albert Shull Award for Outstanding Research in Plant Physiology |
| 1980 | Award for Superior Service, US Department of Agriculture |
| 1980 | Award of Excellence, Weed Science Society of America |
| 1983 | Elected Member of the National Academy of Sciences, USA |
| 1984 | Elected Fellow of the National Academy of Sciences, India |
| 1985 | Elected President, American Society of Plant Physiologists |
| 1990-1997 | Member, Board of Governors of the University of Chicago for Argonne National Laboratory. Member Executive Comm.; Chair of Scientific/Technical Advisory Board |
| 1991-1993 | Member and Chairman, NIH Biotechnology Policy Board |
| 1991-1998 | *SCIENCE* Editorial Board Member |
| 1994 | Dennis Robert Hoagland Award, American Association of Plant Physiologists |
| 1994 | Elected Fellow, AAAS |
| 1997 | Doctor of Science *honoris causa*., Purdue University, School of Science |
| 2001-Present | President George W. Bush's Council of Advisors on Science and Technology, and Presidential appointee to the National Nanotechnology Advisory Board (in 2004) |
| 2003 | Doctor of Science *honoris causa*., University of Minnesota |
| 2004 | American Society of Plant Biology Leadership in Science Public Service Award |
| 2004 | Appointed as Regent's Professor, Arizona Board of Regents |
| 2006 | Botanical Society of America Centennial Award |
| 2007 | Elected Fellow of American Society of Plant Biologists |

**Selected publications and books edited include:**

**Mor, T.S., Sternfeld, M., Soreq, H., Arntzen, C.J., Mason, H.S.** 2001. Expression of recombinant human acetylcholinesterase in transgenic tomato plants. Biotechnology and Bioengineering. 75:259-266.

**Kong Q, Richter L, Yang Y-F, Arntzen CJ, Mason HS, Thanavala Y.** 2001. Oral Immunization with hepatitis B antigen expressed in transgenic plants. Proc. Natl. Acad. Sci. USA 98:11539-11544.

**Mason, H.S., Warzecha, H., Mor, T., Arntzen, C.J.** 2002. Edible plant vaccines: applications for prophylactic and therapeutic molecular medicine. TRENDS in Molecular Medicine. 8:324-329.

**Joshi, L., Van Eck, J.M., Mayo, K., Di Silvestro, R., Blake (Nieto), M.E., Ganapathi, T., Haridas, V., Gutterman, J.U., Arntzen, C.J.** 2002. Metabolomics of plant saponins; Bioprospecting triterpene glycoside diversity with respect to mammalian cell targets. OMICS: J. of Integrative Biology. 6:3:235-246.

**Rigano, M.M., Sala, F., Arntzen, C.J., Walmsley, A.M**. 2003. Targeting of plant-derived vaccine antigens to immunoresponsive mucosal sites. Vaccine. 21:809-811.

**Walmsley, A.M., Arntzen, C.J.** (2003) Plant cell factories and mucosal vaccines. Current Opinion in Biotechnology. 14(2):145-150.

**Arntzen, C.J., Coglan, A., Johnson, B., Peacock, J., Rodemeyer, M. (**2003). GM Crops: Science, Politics and Communication. Nature Reviews Genetics. 4:839-843.

**Smith, M.L., C.J. Arntzen, M.L. Shuler, H.S. Mason** (2003) Structural characterization of plant-derived hepatitis B surface antigen employed in oral immunization studies. Vaccine. 21:4011-21.

**Peterson, R.K.D, C.J. Arntzen** (2004) On risk and plant-based biopharmaceuticals. Trends in Biotechnology. 22(2):64-66.

**Khalsa G, Mason HS, Arntzen CJ**. 2004 Plant-derived vaccines: progress and constraints. In Molecular Farming, Ranier and Schillberg, eds. John Wiley and Sons. Wiley: Weinheim. p. 135-58.

**Mor, T.S., Mason, H.S., Kirk, D.D., Arntzen, C.J. and Cardineau, G.A.** (2004) Plants as Production and Delivery Vehicle for Orally Delivered Subunit Vaccines. In New Generation Vaccines, M.M. Levine, R. Rappuoli, M.A. Liu and M.F. Good, Editors. Marcel Dekker, Inc., New York-Basel. Third Edition; p. 305-312.

**Khalsa G, Mason HS, Arntzen CJ**. (2005) Plant-derived vaccines: progress and constraints. In Molecular Farming, Ranier and Schillberg, eds. John Wiley and Sons.

**Mason HS, Chikwamba R, Santi L, Mahoney RT, Arntzen CJ** (2004) Antigen delivery systems: Transgenic plants for mucosal vaccines. In: Mucosal Immunology, 3rd Edition. Section D. Mucosal Vaccines (McGhee JR, Mestecky JF, Eds) Elsevier Science, London, 2004, pp. 1053-1060.

**Thanavala, Y., M. Mahoney, S. Pal, A. Scott, L. Richter, N. Natarajan, P. Goodwin, C.J. Arntzen, H.S. Mason**. 2005. Immunogenicity in humans of an edible vaccine for hepatitis B. Proc. Natl. Acad. Sci., U.S. 102:3378-3382.

**Matoba N, Magérus A, Geyer BC, Zhang Y, Muralidharan M, Alfsen A, Arntzen CJ, Bomsel M, Mor TS.** (2004) A mucosally targeted subunit vaccine candidate eliciting HIV-1 transcytosis-blocking Abs. Proc Natl Acad Sci U S A. 101(37):13584-9.

**Maloney BJ, Takeda N, Suzaki Y, Ami Y, Li TC, Miyamura T, Arntzen CJ, Mason HS.** 2005. Challenges in creating a vaccine to prevent hepatitis E. Vaccine 23:1870-4.

**Huang Z, Elkin G, Maloney BJ, Beuhner N, Arntzen CJ, Thanavala Y, Mason HS. 2005.** Virus-like particle expression and assembly in plants: hepatitis B and Norwalk viruses. Vaccine 23: 1851-8.

**Arntzen C, Plotkin S, Dodet B.** 2005. Plant-derived vaccines and antibodies: potential and limitations. Vaccine 23: 1753-6.

**van der Laan JW, Minor P, Mahoney R, Arntzen C, Shin J, Wood D.** (2005) WHO Informal Consultation Group. Informal consultation on scientific basis for regulatory evaluation of candidate human vaccines from plants. Vaccine. 24(20):4271-8.

**Santi L, Giritch A, Roy CJ, Marillonnet S, Klimyuk V, Gleba Y, Webb R, Arntzen CJ, Mason HS.** (2006) Protection conferred by recombinant Yersinia pestis antigens produced by a rapid and highly scalable plant expression system. Proc Natl Acad Sci U S A. 2006 103(4): 861-866.

**Huang Z, Santi L, LePore K**, **Kilbourne J, Arntzen CJ, Mason HS.** (2006) Rapid, high-level production of hepatitis B core antigen in plant leaf and its immunogenicity in mice. Vaccine. 24(14):2506-13

**Lee KY, Kim DH, Kang TJ, Kim J, Chung GH, Yoo HS, Arntzen CJ, Yang MS, Jang YS.** (2006). Induction of protective immune responses against the challenge of Actinobacillus pleuropneumoniae by the oral administration of transgenic tobacco plant expressing ApxIIA toxin from the bacteria. FEMS Immunol Med Microbiol. 48(3):381-9.

**Saldaña S, Esquivel Guadarrama F, Olivera Flores Tde J, Arias N, López S, Arias C, Ruiz-Medrano R, Mason H, Mor T, Richter L, Arntzen CJ, Gómez Lim MA.** (2006). Production of rotavirus-like particles in tomato (Lycopersicon esculentum L.) fruit by expression of capsid proteins VP2 and VP6 and immunological studies. Viral Immunol. 19(1):42-53.

**Santi L, Batchelor L, Huang Z, Hjelm B, Kilbourne J, Arntzen CJ, Chen Q, Mason HS**. An efficient plant viral expression system generating orally immunogenic Norwalk virus-like particles. 2008. Vaccine 26, 1846—1854.

# Dorothea Bartels
## CURRICULUM VITAE

| | |
|---|---|
| 28. 10.1951<br>Nationality: | Born in Hannover (Germany)<br>German |
| December 1975 | University degree (Staatsexamen) in biology and chemistry for this preparation of an experimental work in enzymology "Purification and characterization of ribonucleotide synthesizing enzymes in plant cell cultures". |
| 1976-1979 | Experimental work for the doctoral thesis at the Institute of Botany, University of Hannover, with Professor Dr. G. Richter. Problem: Characterization and relationship between hnRNA and mRNA from plant cell cultures. |
| May 1979 | Examination for the Ph.D. degree in botany, zoology and chemistry |
| June 1979-<br>June 1980 | Research with Professor Dr. K. Kloppstech: Isolation of light induced mRNAs and their expression in developing barley leaves. |
| August 1980 - | Fellowship from The German Research Council (DFG) to work at the Plant Breeding Institute, Cambridge (U.K.) in Dr.R.B. Flavell's group on construction and analysis of cDNA clones encoding cereal storage proteins. |
| September 1982 - | Continue to work at the Plant Breeding Institute supported by an EEC research grant in the Biomolecular Engineering Programme to work on the project: „Isolation, analysis and manipolation of wheat storage protein genes“with respect to two areas of research. 1. Relationship between gene structure and biophysical properties of encoded proteins. 2. Regulations of tissue- and time-specific expression of storage proteins genes. |
| Since January 1986 | Senior research scientist at the Max-Planck-Institut für Züchtungsforschung (Cologne, FRG) in the department of Professor Dr. F. Salamini to investigate the problem of desiccation in plants on the molecular level using two erxperimental systems: the developing cereal embryo and resurrection plants. |
| 1993 | Habilitation at the University of Hannover. Subject: Molecular studies on drought stress and cold stress in barley and model plants. |
| March 1997 | Professor of Botany (C3) University of Bonn |
| October 2000 | Prorector of the University of Bonn |
| May 2001 | Professorship in Ecology and Physiology of Plants Vrije Universiteit, Amsterdam |

May 2001 EMBO member

July 2001 Theodor Bücher lecture FEBS meeting Lisbon

April 2003 Professor of Botany (C4), University of Bonn

May 2004 Editor in Chief of Planta

October 2005 Vice Dean of the Faculty of Science

D. Bartels Publications last five years


Kirch H.-H., Philips J., Bartels D. (2002) Dehydration stress signal transduction. In Plant Signal Transduction: Frontiers in Molecular Biology. Eds.: Scheel D. and Wasternack C. Oxford University Press pp.140-164

Phillips J. R., Oliver M.J., Bartels D. (2002) Molecular genetics of desiccation and tolerant systems. In CAB International Desiccation and Survival in Plants: Drying without dying Eds.: M. Black and H. Pritchard pp. 319-341

Ramanjulu S., Bartels D. (2002) Drought and desiccation-induced modulation of gene expression in plants. Plant Cell & Environment 25, 141-151

Deng X., Meijer A H., Salamini F., Bartels D (2002) Characterization of five novel dehdration responsive homeodomain leucine zipper genes from the resurrection plant Craterostigma plantagineum Plant Mol. Biology 49, 601-610

Chandler J W., Bartels D. (2003) Drought avoidance and drought adaptation in The Encyclopedia of Water Science eds. B.A. Stewart, T. Howell Marcel Dekker New York 163-165

Phillips J., Hilbricht T., Salamini F., Bartels D. (2002) A novel abscisic acid and dehydration responsive gene family from the resurrection plant *Craterostigma plantagineum* encodes a plastid targeted protein with a coiled-coil domain. Planta 215, 258-256

Rodrigo M., M-J., Moskovitz J., Salamini F., Bartels D. (2002) Reverse genetic approaches in plants and yeast suggest a role for novel, evolutionary conserved, selenoprotein-related genes in oxidative stress defense Mol. Gen. Gen. 267, 613-627

Hilbricht T., Salamini F., Bartels D. (2002) Cp*R18*, a novel SAP-domain plant transcription factor, binds to a promoter region necessary for ABA mediated expression of the *CdeT27-45* gene from the resurrection plant *Craterostigma plantagineum* Hochst. The Plant Journal 31(3), 293-304

Bartels D., Mattar M. (2002*) Oropetium thomaeum*: a resurrection grass with a diploid genome Maydica 47, 185-192

Kotchoni S., Bartels D.(2003) Water stress induces the up-regulation of a specific set of genes in plants: aldehyde dehydrogenases as an example. Bulgarian Journal of Plant Physiology 37-51

Hilbricht T., Bartels D. (2003) Das Geheimnis der Austrocknungstoleranz Biologie in unserer Zeit 33(2), 3-11 Sunkar. R., Bartels D., Kirch H-H (2003) Overexpression of a stress-inducible aldehyde dehydrogenase gene from Arabidopsis thaliana in transgenic plants improves stress tolerance. The Plant Journal 35 (4) 452-454

Bartels D., Souer E. (2003) Molecular responses of higher plants to dehydration Topics in Current Genetics (eds. H. Hirt and K. Shinozaki) Springer Verlag Berlin, Heidelberg, New York "Plant responses to abiotic stress" 9-38

Smith-Espinoza C., Richter A., Salamini F., Bartels D. (2003) Dissecting the rersponse to dehydration and salt (NaCl) in the resurecction plant *Craterostigma plantagineum* Plant Cell & Environment 26 (8) 1307-1315

Bartels D. (2004) Molekulare Ansätze zur Untersuchung von Trockentoleranz Vorträge für Pflanzenzüchtung 63, 23-24

Rodrigo M.J., Bockel C., Blervacq A.S., Bartels D (2004) The novel dehydration stress responsive gene *CpEdi-9* isolated from the resurrection plant *C. plantagineum* is expressed transiently in vascular tissues of leaves during dehydration and in seeds Planta 219, 579-589

Villalobos MA., Bartels D., Iturriaga G. (2004) Stress Tolerance and Glucose Insensitive Phenotypes in Arabidopsis Overexpressing the *CpMYB10* Transcription Factor Gene Plant Physiology (2004)135 (1). 309-324

Bartels D., Ditzer A., Furini A. (2006) What can we learn from resurrection plants? in Drought Adaptation in Cereals Hayworth Publisher (ed. J.-M. Ribaut), 599-622

Kirch H.H., Bartels D., Wei Y., Schnable P., Wood A. (2004) The aldehyde dehydrogenase gene superfamily in *Arabidopsis thaliana* Trends in Plant Science 9(8), 371-377

Kirch H.H., Schlingensiepen S., Kotchoni S., Sunkar R., Bartels D. (2004) The aldehyde dehydrogenase (ALDH) gene superfamily in *Arabidopsis thaliana*: expression analysis of selected members in response to osmotic stress and the phytohormone ABA Plant Molecular Biology 57, 315-332

Bartels D., Sunkar R (2005). Drought and salt tolerance in plants Critical Reviews in Plant Science 21, 1-36

Rahmanzadeh R., Müller K., Fischer E., Bartels D., Borsch T.(2005) The Linderniaceae and Gratiolaceae are further lineages distinct from the Scrophulariaceae (Lamiales) Plant Biology 7, 1-12

Smith-Espinoza C., Phillips J., Salamini F., Bartels D. (2005) Identification and analysis of *Craterostigma plantagineum* mutants affected in abscisic acid mediated desiccation tolerance Mol. Gen. Genomics 274(4), 364 - 372

Reyes J.,Rodrigo, M.,Colmenero-Flores M., Gil J.,Garay-Arroyo A., Campos F. Salamini F., Bartels D., Covarrubias A. (2005) Hydrophilins from distant organisms can protect enzymatic activities from water limitation effects *in vitro* Plant Cell and Environment 28, 709-718

Bartels D. (2005) Desiccation tolerance studied in the resurrection plant *Craterostigma plantagineum* Integrative and comparative Biology 45, 696-701

Kotchoni, S.Kuhns C., Ditzer A., Kirch HH., Bartels D.(2006): Overexpression of different aldehyde dehydrogenase genes in *Arabidopsis thaliana* confers tolerance to abiotic stress and protects plants against lipid peroxidation and oxidative stress Plant Cell & Environment 29, 1033-1048

Xin Deng[a,c,1], Jonathan Phillips[a,b,1], Anne Bräutigam[a], Peter Engström[d], Henrik Johannesson[d], Pieter B.F. Ouwerkerk[e], Ida Ruberti[f], Julio Salinas[g], Pablo Vera[h], Rina Iannacone[i], Annemarie H. Meijer[e] and Dorothea Bartels[a] (2006) A homeodomain leucine zipper gene from Craterostigma plantagineum regulates abscisic acid responsive gene expression and physiological responses Plant Molecular Biology 61, 469-489

Ditzer A., Bartels D. (2006): Identification of stress-responsive promoter elements and isolation of corresponding DNA binding proteins for the LEA gene *CpC2* promoter Plant Molecular Biology 61, 643-663

Röhrig H., Schmidt J., Colby T., Bräutigam A., Hufnagel P., Bartels, D (2006): Desiccation of the resurrection plant *Craterostigma plantagineum* induces dynamic changes in protein phosphorylation Plant Cell & Environment 29 (8), 1606-1617

Bartels D., Phillips J., Chandler J. (2007) Desiccation tolerance: gene expression, pathways and regulation of gene expression in *Plant desiccation tolerance* Blackwell Publishing (eds. M. Jenks, A. Wood) Blackwell Publishing Ames, Iowa, USA, pp 115-150

Bartels D., (2007) Francesco Salamini: Plant Genetecists and Plant Breeder, Plant Breeding Reviews (27)

Phillips J., Dalmay T., Bartels D (2007) The role of small RNAs in abiotic stress FEBS Letters 581: 3592-3597

Smith-Espinoza C**.,** Bartels D., Phillips J.(2007),GFP as a tool to monitor *LEA* gene promoter activity in the desiccation tolerant plant *Lindernia brevidens* Plant Cell Reports 26 (9): 1681-1688

Carvalho M., Pinheiro C., Bartels D., Ricardo C., Chaves M. (2008) Dehydrins in *Lupinus albus*: pattern of protein accumulation and gene expression in response to drought. Functional Plant Biology 35, 85-91

Furini A, Varotto S. Borgato L., Hilbricht T, Sgaramella V,. Salamini F, Bartels D. (2008): Plant resurrection, SINE retrotransposons and siRNA: environment-mediated evolution of desiccation tolerance, New Phytologist (in press)

Phillips J., Fischer E., Baron M., van den Dries N., Facchinelli F., Kutzer M., Rahmanzdeh R., Remus D., Bartels D.(2008) *Lindernia brevidens*, a novel desiccation tolerant vascular plant, endemic to ancient tropical rain forest Plant Journal (in press)

Bartels D., Hussain S.S. (2008) Current status and implications of engineering drought tolerance in plants using transgenic approaches CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources (in press)

Phillips J., Bartels D. (2008) Molecular Aspects of Desiccation tolerance in *Craterostigma plantagineum* The Biochemist (in press)

Röhrig H., Schmidt J., Colby T., Harzen A., Facchinelli F., Bartels D. (2008) Analysis of the *Craterostigma plantagineum* desiccation phosphoproteome using a modified metal oxide affinity chromatography procedure Proteomics (in press)

**EDUARDO BLUMWALD**

*Professor of Cell Biology and Will W. Lester Chair,*
*Department of Plant Sciences, UNIVERSITY OF CALIFORNIA, DAVIS, CA 95616.*
*Tel: 530-752-4640; FAX: 530-752-2278; email: eblumwald@ucdavis.edu*

**Education**

| | | | |
|---|---|---|---|
| Hebrew University, Jerusalem, Faculty of Agronomy | B.Sc. | 1980 | Soil Sciences |
| Hebrew University, Jerusalem, Faculty of Agronomy | M.Sc. | 1981 | Plant Physiology |
| Hebrew University, Jerusalem and UC Berkeley | Ph.D. | 1983 | Bioenergetics |

**Professional experience**

| | |
|---|---|
| 2006-Present | Adjunct Professor of Cell Biology, Dept of Life Science, Pohang University of Science and Technology, Korea. |
| 2001- present: | Professor and Will W. Lester Chair, Department of Plant Sciences, University of California, Davis, CA, USA |
| 1995-2000: | Professor, Department of Botany, University of Toronto, Toronto, Canada |
| 1992-1995: | Associate Professor, Department of Botany, University of Toronto |
| 1987-1992: | Assistant Professor, Department of Botany, University of Toronto |
| 1984-1987 | Post-Doctoral Fellow, Biology Dept, McGill University, Montreal, Canada. |

***Honors and awards***

**1987-1992:** University Research Fellow, National Science and Engineering Research Council of Canada; **1996:** Victor Bendelow Memorial Lecturer, University of Manitoba, Canada; **1995-96:** Steacie Memorial Fellow, National Science and Engineering Research Council of Canada, Canada; **1994-96:** Chair, Ontario Graduate Scholarship Program, Canada; **1997-98:** Panel Member, Fund for Improvement of Scientific Education, International Monetary Fund; **1996:** Vice-Chair, Gordon Conference on Salt and Drought Stress in Plants; **1998:** Organizing Committee, 11$^{th}$ International Workshop on Plant Membrane Biology, Cambridge, UK; **2001:** Chair and Organizer, Juan March Symposium on Plant Salt Tolerance, Madrid, Spain; **2001**: Organizing Committee, 12$^{th}$ International Workshop on Plant Membrane Biology, Madison, WI, USA; **2002:** Vice-Chair Gordon Conference on Salt and Drought Stress in Plants; **2000-present**: Member of Editorial Board, *Trends in Plant Sciences*; **1996-2000:** Member of Executive Committee, Protein Production Facility, Ontario Cancer Institute, Canada; **2000-present:** Member, biotechnology internship program Davis High School, Davis, CA; **2000- 2004:** Member, Pomology Extension Continuing Conference; **2002-2003:** Member of NSF Review Panel; **2003:** Organizer, ASPB Western Regional Meeting, Northern California, USA; **2003:** Alexander von Humboldt Prize; **2003-2006:** Member of the Molecular Structure Facility Advisory Committee (UC Davis); **2004:** Member of USDA-NRI Review Panel; **2004-2005:** Member BARD USA-Israel panel review; **2004**: Organizing Committee, 13$^{th}$ International Workshop on Plant Membrane Biology, Montpellier, France; **2004:** Chair and organizer, Gordon Conference on Salt and Drought Stress in Plants; **2005:** Member**,** Organizing Committee, 14$^{th}$ International Workshop on Plant Membrane Biology, Sevilla, Spain; **2005:** Chair BARD USA-Israel panel review, **2005-present:** Member, Steering Committee, UN/FAO-Latin American Consortium for Abiotic Stress, **2005-present**: Member of Editorial Board, *Journal of Biological Chemistry* **2006-present:** Member of Editorial Board, *Plant Science*; **2006-present:** Member of Editorial Board, *Molecular Plant.***2007:** Chair and Organizer, USA-Pakistan symposium on abiotic stress, Davis; **2007:** Member, Int'l and local Organizing committee, Int'l Plant Nutrition Symposium; **2008 – present:** Member TAC, BARD-USA-Israel; **2008:** Japan Society Promotion of Science Fellow.

**Society memberships**

American Association for the Advancement of Science; American Society of Plant Biologists; Canadian Society of Plant Physiologists; Society for Experimental Biology; Argentine Society of Plant Physiology; American Society of Biochemistry and Molecular Biology, Japanese Society of Plant Physiology.

**Selected publications**


Rahman, S., Seraj, Z.I., Blumwald, E. (2007). Bacteriophage Lambda genomic library construction of *Oryza sativa* L. var. Pokkali. *Plant Tissue Cult. & Biotech*. 17: 149-159.

He, C; Shen, G; Paspula, V., Luo, J., Venkataramani, S., Qiu, X., Kupu, S, Kryeyevi, A., Holaday, S., Auld, D., Blumwald, E.,, and Zhang, H. (2007). Ectopic expression of *AtNHX1* in cotton (*Gossypium Hirsutum)* increases proline content and enhances photosynthesis under salt stress conditions. *J. Cotton Sci.* 11:266-274.

Rivero, RM., Kojima, M., Gepstein A., Sakakibara, H., Mittler, R., Gepstein, S., and Blumwald, E. (2007). Delayed leaf senescence induces extreme drought tolerance in a flowering plant. *Proc. Natl. Acad. Sci. USA* 48: 19631-19636.

Katz., E., Fon, M., Lee, Y.J., Phinney, B.S., Sadka, A, and Blumwald, E. (2007). The citrus fruit proteome: insights into citrus fruit metabolism. *Planta:* 226:989-1005.

Cagnac, O., Leterrier, M., Yeager, M. and Blumwald, E. (2007). Identification and characterization of vnx1p, a novel type of vacuolar monovalent cation/$H^+$ antiporter of S*accharomyces cerevisiae. J. Biol. Chem.* 282: 24284-23293.

Hanana, M., Cagnac, O., Yamaguchi, T., Said, H., Blumwald, E. (2007). A grape berry (*Vitis vinifera* L.)cation/$H^+$ antiporter is associated with berry ripening. *Plant Cell Physiol***.** 48:804-811.

Apse, M.P. & Blumwald, E. (2007). $Na^+$ transport in plants. *FEBS Lett***.** 581: 2247-2254.

Shlizerman, L.; Marsh, K.; Blumwald, E. & Sadka, A. (2007). Fe shortage induces citric acid accumulation and reduces the activity of the cytosolic aconitase in citrus fruit vesicles and calli. *Physiol. Plant.*131:72-79.

Eingenheer, R.A., Lee, Y.K., Blumwald, E. & Gelli, A. (2007). The cell surface proteome of the human fungal pathogen *Cryptococcus neoformans. FEMS Yeas Rest.*7:499-510.

Sottosanto, J.B., Saranga, Y. & Blumwald, E. (2007). Impact of AtNHX1, a vacuolar $Na^+/H^+$ antiporter, upon gene expression during salt stress in *Arabidopsis. BMC Plant Biology* 7: 18.

Novak, J.P., Kim, S-Y., Xu, J., Modlich, O., Volsky, D.J., Honys, D., Slonczewski, J.L., Bell, D.A.,Blattner, R., Blumwald, E. *et al.* (2006).Generalization of DNA microarray dispersion properties: microarray equivalent of t-Distribution. Biology Direct 1**:** 27.

Sahi, C., Singh, A., Kumar, K., Blumwald, E. & Grover, A. (2006). Salt stress response in rice: genetics, molecular biology and comparative genomics. *Func.Integr.Genomics.*6: 263-284.

Shimada, T., Nakano, R., Shulaev, V., Sadka, A. and Blumwald, E. (2006). Vacuolar citrate/$H^+$ symporter of citrus juice cells. *Planta* 224:472-480.

Sahi, C., Singh, A., Blumwald, E. & Grover, A. (2006). Beyond osmolytes and transporters: novel plant stress tolerance-related genes from transcriptional profiling data. *Physiol. Plant***.** 127:1-9.

He, C., Yan, J., Shen, G., Fu, L., Holaday, AS., Auld, D., Blumwald, E. & Zhang, H.(2005). Expression of an Arabidopsis vacuolar $Na^+/H^+$antiporter gene in cotton improves performance under salt conditions and increases fiber yield in the field. *Plant Cell Pysiol.* 46:1848-1854.

Yamaguchi, T. and Blumwald, E. (2005) Developing Salt Tolerant Crop Plants: Challenges and Opportunities. *Trend Plant Sci.* 12:615-620.

Yamaguchi, T., Aharon, G.S., Sottosanto, J.B. & Blumwald, E.(2005). Vacuolar $Na^+/H^+$ antiporter cation selectivity is regulated by calmodulin from within the vacuole. *Proc. Natl. Acad. Sci USA* .102:16107-16112.

Sottosanto, J.B., Gelli, A., Blumwald, E. (2004). DNA array analyses of *Arabidopsis thaliana* lacking a vacuolar $Na^+/H^+$ antiporter: Impact of AtNHX1 on gene expression. *Plant J.* 40:752-771.

Yamaguchi, T., Apse, M.P. Apse, Shi, H., Blumwald, E. (2003). Topological analysis of a plant vacuolar $Na^+/H^+$ antiporter reveals a luminal C-terminus that regulates the antiporter cation selectivity. *Proc. Natl. Acad. Sci USA,* 100:12510-12515.

Apse, M.P., Sottosanto, J., Blumwald, E. (2003). Ion homeostasis in *Arabiodpsis thaliana:* role of the vacuolar $Na^+/H^+$ antiporters. *Plant J.* 36: 229-239.

Aharon, G.S., Apse, M.P., Duan, S., Hua, X., Zhang, H-X., Blumwald, E. (2003). Characterization of a family of vacuolar $Na^+/H^+$ antiporters in *Arabidopsis thaliana.Plant Soil* 253: 245-256.

**Name:** **CHRISTINE HELEN FOYER**

**Address:** School of Agriculture,
Food and Rural Development,
Agriculture Building,
The University of Newcastle upon Tyne,
Newcastle upon Tyne,
NE1 7RU.
UK.

**Tel:** 44 (0) 191 2226932
**Fax:** 44 (0) 191 2227811
**Email:** christine.foyer@newcastle.ac.uk

**Nationality:** British

**Date of Birth:** 3 October 1952

**Current Position:** Professor of Molecular Agriculture

**Education and Academic Qualifications:**

| | |
|---|---|
| **1971-1974** | University of Portsmouth, U.K.; B.Sc. 1974 with Class II division I Honours in Biology (CNAA). |
| **1974-1977** | Department of Biochemistry, Kings College, University of London, U.K. Ph.D (1977). |
| **1998** | Fellow of the Institute of Biology. |

**Professional Experience:**

| | |
|---|---|
| **1977-1979** | Postdoctoral scientist Department of Plant Sciences, Kings College, University of London, U.K. |
| **1979-1988** | Snr Research Associate (AFRC), Research Institute for Photosynthesis, University of Sheffield, U.K.. |
| **1988-1994** | Directeur de Recherche, INRA, Versailles, France. |
| **1994-1998** | Head of the Environmental Biology Department, Institute of Grassland and Environmental Research, Aberystwyth, Ceredigion, U.K. |
| **1998-2001** | Head of the Biochemistry and Physiology Department, Institute of Arable Crops Research, Rothamsted, Harpenden, Hertfordshire, U.K. |
| **2001-2006** | Individual Merit Promotion Scientist, Crop Productivity and Improvement Division, Rothamsted Research, Harpenden, Hertfordshire, U.K. |
| **2005** | Professeur invité, Departmente de Structure et Métabolisme des Plantes, Université de Paris-Sud, 91405 Orsay, France. |
| **2006-** | Present position |

**Institute of Scientific Information list of world-wide most cited authors ranking:** CHF is ranked (currently number 7) in the top 10 list of world-wide most cited authors in Plant and Animal Sciences (http://www.in-cites.com/top/2007/fourth07-pla.html). She has been in the top 10 for the past five years and she is the highest ranking woman in Plant and Animal Science citations. Christine Foyer is a specialist in redox biology and antioxidant metabolism, and also in primary carbon and nitrogen assimilation, metabolism and interactions. The

research conducted in the Foyer lab concerns the responses that enable plants to withstand environmental abiotic stresses particularly drought, chilling and $CO_2$ enrichment. A range of transgenic approaches as well as mutants are used to study redox regulation and signalling and the metabolic crosstalk that co-ordinates redox signals and carbon/nitrogen signalling in model (Arabidopsis, tobacco) and crop (maize, soybean, pea) species. The immediate aim of this work is to understand the role of redox processes in the acclimation of photosynthesis and respiration and associated carbon/nitrogen metabolism to environmental stress. The further goal is to identify stress-induced senescence and programmed cell death pathways in leaves and root nodules and to use this information together with systems biology approaches to develop crops that perform more predictability in extreme environmental conditions.

Christine also works closely with colleagues in Africa in capacity building projects to develop a better understanding of the responses that enable plants to withstand environmental abiotic stresses particularly drought and chilling. The ultimate goal of this work is to develop crops that show lower levels stress-induced senescence and death and perform more predictability in the extreme environmental conditions.

Christine promotes gender equality in science and initiated the Women in Science events during the Society for Experimental Biology Main Meetings and other conferences such as FESPB and the recent Photosynthesis Congress 2007. She is also active in supporting public engagement activities and education, particularly in collaboration with partners such as societies of the Biosciences Federation and international societies such as American Society of Plant Biologists.

**PERFORMANCE INDICATORS AND AWARDS (2007-2008)**

2008 Visiting Professor at the University of the West of England
2008 Visiting Professor at the University of Essex,
2008 Member of the Scientific Advisory Board of the ZMBP Universitaet Tuebingen,
2008 Member of the the Scientific Advisory Board (SAB) of the Finnish Centre of Excellence (CoE) in Integrative Photosynthesis and Bioactive Compound Research at Systems Biology Level (2008-2013).
2008 Member of the International Fellowship Panel of the Royal Society (U.K)
2008 Trustee of the Annals of Botany Company and Institute of Biology (U.K.)
2008 Chair of the Fellowship/Membership Committee of the Institute of Biology
2007 Chair of the Education and Public Affairs Committee of the Society for Experimental Biology
2007 Member of SEB Council
2008 Chair of the Grants and Awards Committee, FESPB
2008 Consultant, Unilever Research and Development, Colworth, UK and Pepsico, UK.
2007 Chair of the Organising Committee of the International Congress on Photosynthesis
2007 Grant Review Panel Member for BBSRC initiative 'Selective Chemical Intervention in Biological Systems' (SCIBS);
2007 Sir Frederick McMaster Fellowship, CSIRO, Canberra, Australia

## CURRENT EDITORSHIPS

Associate Editor -Plant, Cell and Environment,
Associate Editor -Journal of Experimental Botany
Associate Editor -Physiologia Plantarum.
Associate Editor-Functional Plant Biology

**CHF HAS PUBLISHED OVER 270 ORIGINAL PAPERS, BOOKS AND REVIEW ARTICLES, 107 HAVE RECEIVED OVER 40 CITATIONS EACH.**

## RECENT PUBLICATIONS


Soares AS, Driscoll SP, Olmos E, Harbinson J, Arrabaça MC and Foyer CH (2008) Adaxial/Abaxial Specification in the Regulation of Photosynthesis with respect to Light Orientation and Growth with $CO_2$ Enrichment in the $C_4$ species Paspalum dilatatum. The New Pytologist. **177:** 186-198

Garmier M, Priault P, Vidal G, Driscoll S, Djebbar R, Boccara M, Mathieu C, Foyer CH and De Paepe R (2008) Light and oxygen are not required for harpin-induced cell death. Journal of Biological Chemistry. **282:**37556-37566.

Hoeberichts FA, Vaeck E, Kiddle G, Coppens E, van de Cotte B, Adamantidis A, Ormenese S, Foyer CH, Zabeau M, Inzé D, Périlleux C, Van Breusegem F and Vuylsteke M (2008) A temperature-sensitive mutation in the *Arabidopsis thaliana* phosphomannomutase gene disrupts protein glycosylation and triggers cell death. Journal of Biological Chemistry. **283:** 5708-5718.

Privat I, Foucrier S, Prins A, Epalle T, Eychenne M, Kandalaft L, Caillet V, Lin C, Tanksley S, Foyer C H and McCarthy J. (2008) Differential regulation of grain sucrose accumulation and metabolism in Coffea arabica (Arabica) and Coffea canephora (Robusta) revealed through gene expression and enzyme activity analysis The New Phytologist. (2008) doi: 10.1111/j.1469-8137.2008.02425.x

Pellny T, Dutilleul C, Wolff T, Groten K, Bor M, De Paepe R Olivier Van Aken, Agnès Reyss Frank Van Breusegem, Noctor G, and Foyer CH (2008) Mitochondrial respiratory pathways modulate nitrate sensing and nitrogen-dependent regulation of plant architecture in Nicotiana sylvestris. Plant J. doi: 10.1111/j.1365-313X.2008.03472.x

Bernard S M, Møller ALB, Dionisio G, Kichey T, Jahn TP, Dubois F, Baudo M, Lopes MS, Tercé-Laforgue T, Foyer CH, Parry M, Forde BG, Araus JL, Hirel B, Schjoerring JK, and Habash D Z (2008) Gene expression, cellular localisation and function of glutamine synthetase isozymes in wheat (Triticum aestivum L.). Plant Molecular Biology. doi: 10.1007/s.11103-008-.9303-y.

Prins A, Van Heerden PDR, Olmos E, Kunert KJ, and Foyer CH (2008) Cysteine proteinases regulate chloroplast protein content and composition in tobacco leaves: a model for dynamic interactions with ribulose-1, 5-bisphosphate carboxylase/oxygenase (Rubisco) vesicular bodies. J. Expt Bot. **In Press**

# Curriculum Vitae

## Cris Kuhlemeier

**Personal Data**


| | |
|---|---|
| date of birth | 28 April 1955 |
| citizenship | The Netherlands |
| address | Institute of Plant Sciences<br>University of Berne<br>CH-3013 Berne<br>Tel: +4131 6314913<br>Fax +4131 631 4942<br>Email: cris.kuhlemeier@ips.unibe.ch |


**Education**

| | |
|---|---|
| Sept. 1973- Dec. 1976 | B.Sc. in Biology / Biochemistry, University of Utrecht, The Netherlands |
| Jan. 1977- Jan. 1980 | M.Sc. in Biology, University of Utrecht |
| March 1980- June 1984 | Ph.D. in Genetics, University of Utrecht |

**Appointments**

| | |
|---|---|
| March 1980- June 1984 | Research Associate, University of Utrecht |
| Sept. 1984- Aug. 1987 | Postdoctoral Fellow, Rockefeller University, New York, USA |
| Sept. 1987- Oct. 1988 | Assistant Professor, Rockefeller University |
| Nov 1988-present | Professor University of Berne, Switzerland |

**Administrative experience**

Head of Department of Biology, University of Berne 2002-2004
Director Institute of Plant Sciences, University of Berne 2006-
Advisory Board Theodor Kocher Institute for Biomedical Research
Assistant Director National Center for Competence in Research "Plant Survival"
Advisor Deutsche Forschungsgemeinschaft
Editor Plant Molecular Biology 1993-2002
Editorial Board "Plant Journal"

### Publications since 2003


1. Vogler, H. and Kuhlemeier, C. Simple hormones but complex signaling. Curr. Opin. Plant Biol. 6: 51-56 (2003).
2. Kürsteiner, O., Dupuis, I., and Kuhlemeier, C. The *pyruvate decarboxylase1* gene of *Arabidopsis* is required during anoxia but not other stresses. Plant Physiol. 132: 968-978 (2003).
3. Reinhardt, D., Frenz, M., Mandel, T., and Kuhlemeier, C. Microsurgical and laser ablation analysis of interactions between the zones and layers of the tomato shoot apical meristem. Development 130: 4073-4083 (2003).

4. Reinhardt, D., Pesce, E.-R., Stieger, P., Mandel, T., Baltensperger, K., Bennett, M., Traas, J., Friml, J. and Kuhlemeier, C. Regulation of phyllotaxis by polar auxin transport. Nature 426: 255-260 (2003).
5. Vogler, H.,Caderas, D., Mandel, T. and Kuhlemeier, C. Domains of expansin gene expression define growth regions in the shoot apex of tomato. Plant Molec. Biol. 53: 267-272 (2003).
6. Stieger, P.A., Meyer, A., Niederhauser, I., Barone, M. and Kuhlemeier, C. The orf13 T-DNA gene of Agrobacterium rhizogenes confers meristematic competence to differentiated cells. Plant Physiol. 135: 1798-1808 (2004).
7. Stuurman, J., Hoballah, M.E., Broger, L., Moore, J. and Kuhlemeier, C. Dissection of floral pollination syndromes in Petunia. Genetics 168: 1585-1599 (2004).
8. Reinhardt, D., Frenz, M., Mandel, T., and Kuhlemeier, C. Microsurgical and laser ablation analysis of leaf positioning and dorsoventral patterning in tomato. Development 132: 15-26 (2005).
9. Stuurman, J. and Kuhlemeier, C. Stable two-element control of *dTph1* transposition in mutator strains of *Petunia* by an inactive *ACT1* introgression from a wild species. Plant J. 41: 945-955 (2005).
10. Hoballah, M.E., Stuurman, J., Turling, T, Connetable, S., Guerin, P., and Kuhlemeier, C. The composition and timing of flower odour emission by wild Petunia axillaris coincide with the antennal perception and nocturnal activity of the pollinator Manduca sexta. Planta 222: 141-150 (2005).
11. Gass, N., Glagotskaia, T., Mellema, . S., Stuurman, J., Barone, M., Mandel, T., Roessner-Tunali, U. and Kuhlemeier, C. Pyruvate decarboxylase provides growing pollen tubes with a competitive advantage in Petunia. Plant Cell 17: 2355-2368 (2005).
12. Barazani, O., Benderoth, M., Groten, K., Kuhlemeier, C. and Baldwin, I.T. *Piriformospora indica* and *Sebacina vermifera* increase growth performance at the expense of herbivore resistance in *Nicotiana attenuata.* Oecologia 146: 234-243 (2005).
13. Smith, R., Guyomarc'h,' S., Mandel,' T., Reinhardt,' D., Kuhlemeier,' C. and Prusinkiewicz, P. A plausible model of phyllotaxis. Proc. Natl. Acad. Sci. USA 103: 1301-1306 (2006).
14. Galliot, C., Stuurman, J., and Kuhlemeier, C. The genetic dissection of floral pollination syndromes. Curr. Op. Plant Biol. 9: 78-82 (2006).
15. Galliot, C., Kuhlemeier, C., and Stuurman, J. Genetic control of flower size and nectar volume in petunia pollination syndromes. Planta 225: 203-212 (2006).
16. Smith, R.S., Kuhlemeier, C. and Prusinkiewicz, P. Inhibition fields for phyllotactic pattern formation: a simulation study. Can. J. Botan. 84: 1635-1649 (2006).
17. Kuhlemeier, C; Sinha N. Growth and development - The diversity of plant development Curr. Opin. Plant Biol. 10: 1-3 (2007).
18. Kuhlemeier, C. Phyllotaxis. Trends in Plant Science 12: 143-1150 (2007).
19. Hoballah, M.E., Gübitz, T, Stuurman, J., Broger, L., Barone, M., Mandel, T., Dell'Olivo, A., Arnold, M., and Kuhlemeier, C. Single-gene mediated shift in pollinator attraction in Petunia. Plant Cell 19: 779-790 (2007).
20. Bainbridge, K., Guyomarc'h, S., Bayer, E., Swarup, R., , Bennett, M., Mandel, T., Kuhlemeier, C. Auxin influx carriers stabilize phyllotactic patterning, Genes Devel. 22: 810-823 (2008).

# APPENDIX B

## List of People who Met with the Committee

The President, Prof. Menachem Magidor
The Rector, Prof. Haim Rabinowitch
The Vice-Rector, Prof. Miri Gur-Arye

Head of Academic Review for the Sciences, Prof. Eliahu Friedman

Dean of the Faculty of Agriculture, Prof. Eli Feinerman
Dean of the Faculty of Science, Prof. Hermona Soreq

Former Head of the Institute, Prof. Alexander Vainstain
Current Head of the Institute, Prof. Baruch Rubin
Former Head of the Institute of Life Sciences, Prof. Yossi Yarom
Head of Life Science Teaching Program, Prof. Michael Brandeis
Chairman of Plant Studies, Prof. Rachel Nechushtai

Study Program Chairpersons (Agriculture):
Prof. Shahal Abbo, Prof. Hanokh Czosnek, Prof. Amnon Schwartz, Prof. Oded Shoseyov, Dr. Nava Moran

Emeriti Faculty (Agriculture):
Prof. Ben-Ami Bravdo, Prof. Uzi Kafkafi, Prof. Eliezer Goldschmidt, Prof. Arie Altman, Prof. Raffi Goren, Prof. Amram Ashri, Prof. Meira Ziv

Emeriti Faculty (Plant Sciences):
Prof. Avraham Max Mayer, Prof. Itzhak Ohad

Sr. Faculty (Agriculture):
Prof. Avigdor Cahaner, Prof. Jaime Kigel, Prof. Elisha Tel-Or, Prof. Dani Zamir, Prof. David Weiss, Prof. Shmuel Wolf

Sr. Faculty (Plant Sciences):
Prof. Avi Shmida, Prof. Aharon Oren, Prof. Shimshon Belkin, Prof. Ronen Kadmon, Prof. Aharon Kaplan, Prof. Joseph Hirschberg, Prof. Alex Levine

Jr. Faculty (Agricultre):
Dr. Yonatan Elkind, Dr. Eyal Fridman, Dr. Jose Grunzweig, Dr. Yehoshua Saranga, Dr. Naomi Ori, Dr. Menachem Moshelion, Dr. Alon Samach

Jr. Faculty (Plant Sciences):
Dr. Nir Keren and Dr. Rachel Green

Dr. Mordechai Shonfeld – in charge of Inter-Departmental Equipment (Agriculture)
Dr. Mira Kohrner – in charge of Genomic Center

| | |
|---|---|
| Meeting with BSc. students in Agriculture | - 4 |
| Meeting with MSc. students in Agriculture | - 8 |
| Meeting with PhD students in Agriculture | - 12 |
| Meeting with BSc. students in Plant Sciences | - 8 |
| Meeting with Msc. students in Plant Sciences | - 10 |
| Meeting with PhD students in Plant Sciences | - 9 |