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PLANT SURVIVAL
National Centre of Competence in Research

Newsletter of the National Centre of Competence in Research (NCCR)
Plant Survival in Natural and Agricultural Ecosystems

Editorial

Building our network

As our project is maturing we are getting on with our research. The first genuine NCCR results are being published and PhD students are finishing their thesis plans while at the same time harvesting their first results. We will soon be working on our second annual report and it is certainly worth reflecting on whether we are well on track with the goals of our project. So - are we on track?

The short answer is - yes. The longer answer will hopefully incite you to read this editorial to its end. As you know, our goals are threefold. First of all, we promised to develop a research network fostering internationally competitive research of the highest quality. On this aspect, we have passed a number of thoroughly conducted evaluation exercises that have confirmed that our overall orientation is fine. In this context, I recall to mind your efforts that went into our answer to the comments of the Review Panel, which were submitted to us after the first annual evaluation. It was good to receive feedback from the Panel and thereby get a feeling for where its members put their priorities. Their remarks about points needing further clarification and discussion initiated a vivid discussion within some groups while at the same time confirmed to others that they were well in line with what the Panel expected.

Furthermore, the competition on how to use our first year's reserve money showed that many of you are already taking advantage of the NCCR network. This is also an area where we should invest more of our precious time, senior researchers and students alike. I firmly believe that through discussions with the other disciplines represented in the NCCR we will develop this open spirit, which will be the foundation for surprising and innovative research as well as for the successful transfer of some aspects of our research.

In the area of knowledge and technology transfer (KTT), one of our other goals, we have accomplished a good deal. The transfer of knowledge, in particular, was on this year's agenda. On this point, the two expositions, "ExpoAgricole" and "Fête la Terre", will leave lasting impressions, especially among the participating students and organisers. We also had a very fruitful meeting with the "Commission for technology and innovation" (CTI) concerning funding possibilities for technology transfer. I was left with the impression that, on the side of the CTI, there is a strong willingness to show some flexibility to accept special or unusual constellations of research partners, as long as it fits the general idea of a technology transfer investment with a potential for the Swiss economy. Hence, we should pursue our ideas on transfer projects and I am sure that funding will follow.

In education, another goal, progress is evident. The Graduate School is flourishing and is enjoying a high degree of satisfaction among the students. Six courses were offered during the past academic year, in total 135 people attended the courses of which 86 were graduate students (49% from Neuchâtel, 31% from Berne & Fribourg, 17% from the rest of Switzerland, 3% from foreign countries).

So, overall I think you will agree with my impression that we are well on track. The important thing now is to keep up our spirit of curiosity to explore new angles of our research; here, I think we have only just started to use synergies from our NCCR- and within group-meetings. Over time we will also see more active involvement of our partners in these meetings, which will open up new interesting possibilities. In conclusion, our fundamental goal should be to do the best possible research using the full potential of the NCCR network to broaden our interactions, while giving the transfer of our research a prominent place in the back of our minds from where it can readily be activated.

Bernd Hägele
NCCR *Plant Survival* co-ordinator
University of Neuchâtel

Moving between Zurich and Neuchâtel

Enrico Martinoia, one of three vice-directors of NCCR *Plant Survival*, has left Neuchâtel to undertake a professorship at the University of Zurich. Likewise, Felix Kessler, researcher at ETHZ, is coming to Neuchâtel where he will pursue his research dealing with chloroplasts.

Neuchâtel – Zurich

With his departure for Zurich, Enrico Martinoia is returning to his roots, since before coming to Neuchâtel he spent six years at the Swiss Federal Institute of Technology (ETHZ). Today, the banks of the Limmat have attracted the professor of plant physiology to a 'rival's' establishment: the university, where he will assume his roles as teacher and researcher at the Institute of Plant Biology. With this nomination, a geographic link in research has been established between Neuchâtel and Zurich. "NCCR's global structure has certainly been modified, but in a positive way, states Enrico Martinoia. Neuchâtel benefits from the competence of someone such as Felix Kessler and the ties with Zurich have been reinforced as well. NCCR *Plant Survival* has taken the shape of a much stronger web."

This appointment has given Enrico Martinoia the opportunity to broaden the scope of the research that he was exploring in Neuchâtel. Still within the framework of NCCR *Plant Survival*, he will continue to study plant cells and the biochemical reactions that permit plants to neutralize toxins or to be drought resistant. "We are interested in three types of plant membrane proteins called ABC transporters. In plants such as *Arabidopsis* or grapevine, we are investigating whether biotic toxins produced by bacteria or fungi can be overtaken by ABC transporters and eliminated from the cell."

Drought resistant plants

However, the interest for these proteins does not end there. They also play a role in drought resistance in plants. Research on *Arabidopsis* has shown a relationship between the ABC transporters and ionic channels that control the movement of sodium or potassium across cellular membranes. The varieties lacking these transporters are more drought resistant, meaning that the stomates, which are equivalent to pores in humans, no longer obey the hormones that regulate their opening mechanism. We are still unclear about the molecular mechanisms associated with this phenomenon. We are dealing with a new area of research of which Enrico Martinoia and his group are pioneers.

As part of NCCR *Plant Survival,* the new professor will stay associated with the Project 3 *(Plant defense mechanisms against biotic toxins)*, which he previously headed, the lead of the project going to Raffaele Tabacchi, from the University of Neuchâtel. A new PhD student from Italy will join the team in Zurich. As for Martinoia's functions concerning project 4 *(Plant nutrition under stress conditions)*, they will remain more or less the same, since his PhD student in charge of that work, Laure Weisskopf, will remain one more year in Neuchâtel before rejoining her thesis supervisor along the Limmat riverside.

Zurich – Neuchâtel

In the city of butter colour stones, **Felix Kessler,** who has left the banks of the Limmat, has officially assumed the position of professor as of October first. An amusing note: it's the second time that Felix Kessler settles in locals previously occupied by Enrico Martinoia. History repeats itself: first in Zurich, then in Neuchâtel. However, at one point, the young successor was able to enjoy a stint at the Rockefeller University in New York, in the laboratory of the 1999 Nobel laureate for Medicine, Günter Blobel.

Felix Kessler's work deals with the interior of plant cells, and focuses on the study of chloroplasts. These organelles house the enzymes of photosynthesis. In other words, they trap solar energy and convert it to chemical energy used for the production of sugars and other molecules essential to plant development. In order to function properly, the chloroplast needs to acquire many photosynthetic proteins that must pass through a double membrane. This researcher and his colleagues are credited with having identified and analyzed *in vivo* the transporters, which take proteins 'by the hand' and lead them into the chloroplast.

This major work was carried out in a well-known model plant, *Arabidopsis thaliana*. The next step that this young professor will concentrate on, is in the identification of new genes that

control other aspects of chloroplast development. Felix Kessler has so far demonstrated that by inactivating the genes responsible for the import of photosynthetic proteins, one obtains an albino plant. In other words, these mutant plants lack chlorophyll and are therefore unable to survive. This discovery, demonstrated in a model plant, is also applicable to field crops such as rice or corn since their genetic makeup is quite similar. Thus, the research of NCCR's new member is directed at universal and key mechanisms of plant growth and survival.

Merging molecular biology and ecology

In Neuchâtel, this new appointee appreciates, above all, the multidisciplinary aspect of his work. "I am very enthused about the idea of collaborating with ecologists, microbiologists and chemists. NCCR is built upon these interactions and continues to strengthen them. The distinctive feature of Neuchâtel (and the new masters program we plan to offer) is the merging of molecular biology and ecology into one entity. In my opinion, this is very progressive and I am not aware of other universities in Switzerland or elsewhere doing this.

Within the framework of NCCR, Felix Kessler will collaborate closely with Sam Zeeman, assistant professor at the University of Berne. Sam Zeeman's research on starch metabolism (cf. PS News no3) is linked to photosynthesis, which in turn relies on chloroplasts. "Our respective work is strongly connected, therefore Sam Zeeman is the ideal partner", says Felix Kessler. Once again, NCCR promotes the cooperation between two research groups that will result in a complementary approach aiming to study the mechanisms of energy intake in plants.

A few words from the expert

Nick Amrhein (see next page), professor at the ETHZ and member of the NCCR *Plant Survival*, knows very well both individuals. Felix Kessler has recently left his lab, whereas Enrico Martinoia has worked with him about fifteen years ago.

"To me personally, the departure of Felix is a real loss, states Nick Amrhein. Felix is a very communicative person who has the ability to attract excellent students. The secret of his success here in Zurich was to have linked biochemistry and molecular biology, which comprise the core of his research on chloroplast development and function in Arabidopsis. In all honesty, during the last five years that I have known him, I do not recall any fits of anger or clashes. Felix is a very positive person."

As for Enrico Martinoia, his first stay in Zurich also evokes memorable souvenirs for Nick Amrhein. "Enrico arrived in 1988 as a senior co-worker. He worked in the same laboratory that he passed on, six years later, to Felix Kessler. His work on vacuoles conveyed original and innovative ideas. In addition, his knowledge on cellular transporters filled a gap in that area, resulting in a success that we are well aware of."

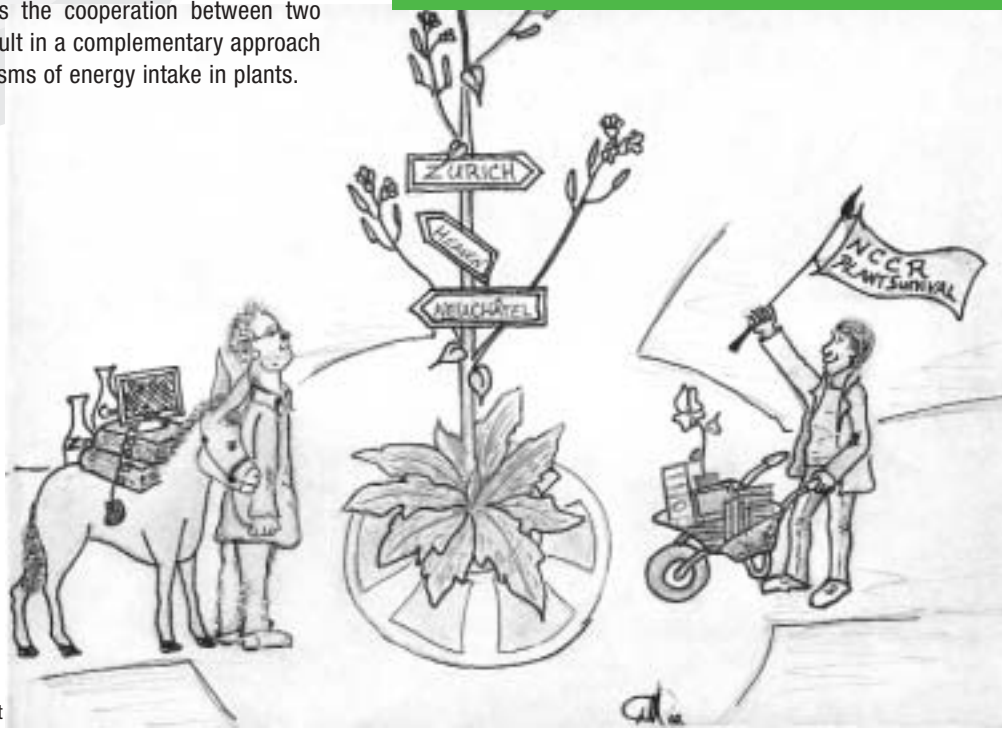

Illustration: Denis Nobert

People

Teaching, the hidden jewel of research

This year, Nick Amrhein will celebrate his sixtieth birthday. A portrait of a biochemist whose passion is teaching and for whom today, the laboratory proved to be a remarkable breeding ground for future professors such as Enrico Martinoia and Felix Kessler.

Since the start of the new academic year, Nick Amrhein must feel somewhat alone in his lab at the Swiss Federal Institute of Technology in Zurich (ETHZ), where he has been a professor since 1987. Three groups in his research section will cease their activities. However, contrary to how it appears, this restructuring is rather a sign of success. In fact, the three responsible for those groups (Felix Kessler, Andreas Schaller and Peter Macheroux) have received professorships in other universities, an undeniable proof of success for their mentor !

In the course of his career, this professor of German origin has given the opportunity to five researchers who, having passed through his lab in Zurich, have become university academics of the highest rank. Among those lucky candidates, are two members of the NCCR, Felix Kessler and Enrico Martinoia.

So what is Nick Amrhein's secret for luring such excellent people? “It certainly is my intention to attract independent individuals who bring with them their own projects, or who are capable of developing them. Professors are judged by the results of their research, nevertheless it is their responsibility to train the next generation to ensure continuity in their field.”

Biology and birdcalls

Nick Amrhein’s engagement, other than offering life science courses to students from different walks of life (which even included field trips on identifying birds and their calls!), was to occupy on two occasions the position of dean of the biology department, first at the Ruhr-Universität Bochum, and then at the ETHZ. Based on his experience, how would he rank the students of today?

“Contrary to those of us who were influenced by the events of May 1968, today’s generation is very concerned about the future while, at the same time, not trying to change the world. I see in a certain number of them a great sense of responsibility towards the environment and the ecology. On the other hand, I also feel that they are less prepared to undertake studies.” The blame lies in reforms of the schooling system that resulted in a lower level of general knowledge in the sciences. The first year of university tends to be a round of selection, instead of a stepping-stone towards higher learning.

Grapevine on the terrace at ETHZ

A pioneer of herbicide mode of action

In 1980, while stationed at Ruhr-Universität Bochum, Nick Amrhein and his PhD student Hans Steinrücken (now also in Switzerland, with Syngenta) discovered a key enzyme that explained the mechanism of a herbicide widely used in agriculture, which is glyphosate. A fundamental research that enabled Monsanto, ten years later, to market the genetically modified Roundup-Ready soybeans, which are glyphosate resistant.

More generally, Nick Amrhein took interest in the synthesis of aromatic amino acids –indispensable in plant metabolism– which animals and humans have to ingest with their food. The strong point of his research was to highlight the enzymes that are involved in their synthesis.

In the framework of NCCR, Nick Amrhein and his PhD student Isabelle Wagschal are studying the possible involvement of aromatic amino acid biosynthesis in the resistance of the grapevine to downy mildew, which is characteristic of certain varieties. The goal of this exercise is to determine to which extent these traits are transferable to non-resistant varieties.

From the vineyard to the laboratory

Former wine-grower turned scientist, Olivier Viret paints a portrait of a unique individual. Well aware of both the interests of the practioner and of the researchers' competences, this agronomist of the Federal Research Station in Changins is the perfect voice for the world of viticulture.

Olivier Viret, what was your professional career path like?

I first started working as a wine-grower in Saint-Blaise in the Canton of Neuchâtel. This led to studies in agronomy at the Swiss Federal Institute of Technology in Zurich (ETHZ) and ended with a PhD in mycology from the same school. That was in 1993 and two weeks later, after having successfully defended my thesis, I was hired at the Federal Research Station in Changins. That worked out nicely because I felt like going back to the field of viticulture.

One could say that you are a rarity in the academic world: a wine-grower converted into a scientist…

Exactly. This double formation naturally leads me to think that we cannot only look at the plant's characteristics but also its environment as a whole. It's true in agriculture and in science as well. In most cases, researchers tend to work with simplified systems using model plants such as Arabidopsis. Whereas problems associated with grapevine and fruit trees that farmers are faced with are linked to exterior organisms (fungi, toxins, bacteria), which brings about the necessity of experimental field sites to test for solutions. Which is where we come in.

Therefore the research you are doing corresponds well with the general direction that the NCCR has set for itself: the relationship between plants and their environment.

Yes indeed, our vision and expertise here in Changins complement nicely the project on grapevine led by Jean-Marc Neuhaus, from the University of Neuchàtel, which deals with genetic factors linked to disease resistance. It's a real plus that it turned out that way.

On which basis does your line of research have good chances of expanding?

In the last twenty or so years, wine-growers have no longer been satisfied in choosing plants solely for the intrinsic value of the fruit. More and more, plant protection is an economic argument that is unavoidable. We try to obtain disease resistant varieties to avoid repetitive treatments in the vineyards. In this context, for the past six years we have been growing, on our experimental sites, grapevines resistant to downy mildew, such as the variety Solaris. Thanks to biochemical studies, guided by Roger Pezet, we were able to show that this resistance was induced by stilbenes, chemical substances secreted by the plant which, above a certain threshold, cause the death of the fungus responsible for the disease. The symptoms on the resistant variety are limited to micro necrosis on the leaves, which in no way affects the quality of the fruit.

What can we say about the current state of the Swiss grapevine?

We can say that 99% of the wine varieties grown in our country are susceptible to diseases caused by fungi. This means that grapevines must be treated periodically. However, as I mentioned previously, varieties resistant to downy mildew, for example, do exist. In the white grapes we find Solaris, Johanniter and also Seyval Blanc. In the red grapes there is the Regent variety, which comes from Germany.

However, there is a hitch of historic importance, which is the link between the region and the type of grapes traditionally grown there. Despite the fact that Johanniter and Solaris result in very interesting wines, they are far from competing with the traditional Chasselas, even though during certain wine tasting events one could hardly tell the difference.

Having said that, the grapevine, especially in French-speaking Switzerland, is suffering from a disease that is spreading. The culprit is Esca, a fungal disease found in the woody part of the grapevine that enters through wounds caused by pruning. Whereas, a few years ago, the stocks were replaced every 20 to 25 years and those that were most infected disappeared without anyone really noticing the disease. Today, however, it's not uncommon to find 30 year old grapevines, of which the number of plants showing symptoms of Esca is quite considerable. The damages are economically important, which justifies the research that we are conducting in this area.

News from the labs

Plant Survival at Expoagricole: More than 10,000 visitors in three days

In Morat, the exhibition "Vivre la recherche sur les plantes/Pflanzenforschung erleben" (July 23-25) attracted some 10,000 people. Alongside eight other exhibitors coming from the academic world and the industry, NCCR *Plant Survival* focused its presentations around four themes: wildflower strips, grapevine diseases, interactions between the soil and roots, interactions between plants and insects. The success of this event can be attributed to the researchers who extended their knowledge to one and all. And, one might add, with genuine pleasure in doing so, as can be deduced from the comments gathered after the exposition.

Sven Bacher: "Although the majority of comments were positive, I particularly enjoyed the more critical discussions with the Swiss farmers. I believe that these types of confrontations are necessary in order to adjust both positions. It invites the farmers to familiarize themselves with new concepts in the control of pests and forces us, the scientists, to stop hiding behind our academic ivory tower."

Britta Tschanz: "I was not expecting such enthusiasm from the public concerning the biological control of weeds. It was also an opportunity to meet other members of NCCR in a different context, to get to know them better and to share experiences. Expoagricole turned out to be a very pleasant event for me to participate in."

Sven, from the University of Bern, is a major co-worker in one of the NCCR research projects and also supervises the diploma thesis of Britta. He is exploring methods of biological weed control in wildflower strips, which are maintained to increase the biodiversity in agricultural areas.

Isabelle Wagschal: "I'm very happy to have been able to participate in such an event, to have met grapevine growers and also people who simply love to eat table grapes. I learnt a lot from them and hope that I, in turn, was able to help them better understand the kind of research that I do."

Isabelle is doing her PhD thesis at ETHZ under the supervision of Nick Amrhein. She is studying gene expressions involved in the control of amino acids with respect to the grapevine resistance to certain diseases.

Cristina Tamò: "I really appreciated the two days I spent at Expoagricole in Morat. I believe that every once in a while it's good to explain our research to people who are not part of the academic circle. Our exhibition was particularly well received by the general public because our visuals were accompanied by both German and French captions, while most other exhibitors only bothered having their posters in German."

Cristina is doing her PhD with Ted Turlings at the University of Neuchâtel. She's looking at the interactions between maize, leaf caterpillar and wasps that parasitize these caterpillars.

Sven Bacher (left) contemplating a wildflower strip

New projects of the NCCR *Plant Survival*

After having closed the first year's budget, the directorial committee initiated a call for proposals on how to spend the money, left untouched, in the reserve fund. The committee received 11 proposals with funding requirements close to 3 times the amount available. Selection criteria were devised where NCCR integration, ongoing or potential for knowledge and technology transfer, and scientific aspects were given equal weight.

Each member of the directorial committee evaluated each proposal independently and during the meeting of June 24th the evaluation points were tallied. It was then decided to fund the top scoring projects, some only partially, until the budget was exhausted. The committee felt that this exercise was a great success and an important step towards enhancing NCCR's project integration and collaboration with the partners.

The following projects received funding:

- The use of molecular techniques to measure cross-effects between pathogen- and insect-induced defence reactions in maize. (B. Mauch-Mani & T. Turlings, Neuchâtel)

  Resistance against micro-organisms is often mediated by a signalling cascade that involves salicylic acid as a second messenger, while defense against leaf chewing herbivores is mostly regulated by the jasmonic acid pathway (octadecanoid pathway). It will be determined if the expression level of the different defense related marker genes are influenced by concurrent attacks of the fungus and the insects.

- Novel approaches to induce resistance against *Botrytis cinerea*. (J.-P. Métraux, Fribourg)

  Recent observations of the protection of *Arabidopsis* against infection by *Botrytis* (linked to cutin degradation and overproduction of the polygalacturonase-inhibiting protein) will be further developed and integrated into ongoing field tests with *Vitis*.

- Analysis of *Petunia*-insect interactions in natural habitats (C. Kuhlemeier, Bern)

  Supplementing experiments with commercially available pollinators in the greenhouse at Bern, the project will extend the group's studies on *Petunia*-insect interactions into the natural habitat of *Petunia* at Uruguay.

- Induced resistance in grapevine: from laboratory to field (G. Défago, Zürich; B. Mauch-Mani, Neuchâtel; L. Tamm, FiBL)

  Resistance in plants can be induced by pathogenic or root colonizing microorganisms and numerous synthetic or biological compounds deprived of a direct antibiotic effect. An assay will be developed to test the induction of resistance of grapevine against downy mildew following induction with the chemical ß-amino butyric acid (BABA). This study will be used to screen published inducers of resistance; inducers showing a potential for protection of grapevine in the *in vitro* assay will be tested under field conditions at FiBL.

- Below-ground herbivory of maize by larvae of the beetle *Diabrotica virgifera* and tritrophic interactions with an entomopathogenic nematode (T. Turlings, Neuchâtel; U. Kuhlmann, CABI)

  Group 7 wants to include this economically important insect in their studies as a below-ground model that commonly co-occurs with various above-ground herbivores. In the context of tritrophic interactions the group will also study the plant's interactions with an entomopathogenic nematode that attacks the beetle larvae and shows great promise for *Diabrotica* control in small-scale (garden) farming.

- Development of insect phenology models for pests of vineyards (P. Guerin, Neuchâtel, P.-J. Charmillot, Changins; A. Davison, EPFL)

  First results of a new forecast model show a high variability in the parameters of the model with respect to years and plots. It is hypothesized that the poor performance of the model is due to missing factors and lack of data or knowledge. Further studies testing hypotheses concerning missing factors will be conducted and the additional data obtained will improve the forecast model.

Bernd Hägele, NCCR co-ordinator

News from the labs

"Fête la Terre" or Back to School for NCCR

It is in the building of the '*Ecole cantonale des métiers de la terre et de la nature*' (ECMTN) in Cernier that NCCR *Plant Survival* was invited to present some of its activities. Colourful posters brightened up the atmosphere on the weekend of August 24th and 25th. A successful exercise in science popularization, which required tact and eloquence on the part of the motivated researchers. All of that in a festive rural setting.

Mollah Md. Hamiduzzaman **(Hamid)**, PhD student in biochemistry: "It was a very pleasant gathering, with a diverse public made up of kids, teenagers, farmers and older people. I discovered just how much the Swiss love grapevines. Visitors were able to observe symptoms of downy mildew, not only with the naked eye, but under the microscope as well."

Laurent Barnavon, postdoc in biochemistry: "In my opinion, the DNA extraction from the tomato was very interesting. It attracted non-scientific people who took the opportunity to see what DNA is all about and also to inquire about GMO's, each with their own views on the subject. I even spotted some biology teachers who wanted to know more on the subject so they could present it to their students."

Bernard Jean-Denis, PhD student in chemistry: "Despite the highly technical aspect of the subject that I was presenting (chromatography), I noticed that by using analogies in our explanations we are able to interest a large number of people. In this case, the similarities that exist between separating either the colours from a product or the components in a chemical solution."

Nicola Schoenenberger, PhD student in botany: "The controversy surrounding GMO's is still often debated on an emotional level and extreme opinions and prejudices are in plentiful supply. I appreciated the fact that we were able to initiate dialogues with the public in all objectivity. We felt that there was a need for impartial information that was not a publicity stunt for a certain cause."

A day in the wildflower strips

The workshop on September 5th that was held at the University of Fribourg and organized by Armin Bischoff, attracted 23 participants. The attendees included researchers and representatives from partner organizations and institutes such as FiBL, LBL, or FAL.

The goal of the get-together was to present the project 8 of the NCCR Plant Survival, which is to determine the importance of the seed origin in wildflower strips and the biological control of the thistle *Cirsium arvense* in these ecological compensation strips. The point was to initiate a discussion between researchers working in similar areas and to obtain comments from specialists from the agricultural world.

Coming from NCCR, Armin Bischoff and Sven Bacher presented parts of their projects from their respective universities (Fribourg and Berne). The first one looked at the importance of seed origin. The second one dealt with the control of the weed *Cirsium arvense* using biological methods that include the use of a natural enemy such as the beetle *Cassida rubiginosa* or the dung-beetle *Apion onopordi* to act as vectors that transmit to the weed the rust fungus *Puccinia punctiformis*.

Among those presenting was Jacques Studer who has been studying since 1995 the biodiversity in wildflower strips. As a consultant to farmers in the canton Fribourg, with whom he works very closely, this biologist has made an astonishing observation: a sustainable increase in biodiversity should in the long run supersede the sowing of ecological compensation areas.

In the afternoon the participants visited the experimental field in Düdingen where Armin Bischoff, Sven Bacher and their collaborators work. There they saw that the differences linked to the place of origin of the seeds were not solely geographic in nature. The habitat, the genetic diversity of the seeds, the growing conditions of the mother plant and finally the seed storage all play a role. These four factors are currently being studied at the site in Düdingen.

Commission for Technology and Innovation

Representatives from the Commission for Technology and Innovation (CTI) were in Neuchâtel on Monday, August 26th to present this organization under the authority of the Federal Department of Economic Affairs to the researchers of NCCR *Plant Survival* and its partners.

The aim of the CTI is to facilitate the transfer of knowledge and technology by supporting scientific projects with high economic potential. This represents a possibility of financing for the members of NCCR.

First condition: find a company that will assume the commercialization of the results and that is willing to finance half of the overall budget. This company must not necessarily come solely from the industry. Non-profit independent research institutes can also be suitable (for example CABI, the *Service romand de vulgarisation agricole* and its German counterpart LBL).

Once the partnership is established, the CTI commits itself to financing the other part asked for, which represents mainly the salaries of the academic partner. This is where the second condition comes into effect: the non-academic partner pays out 10 to 20% of its contribution in the form of cash flow to be used for overhead costs, which are generally not covered by the CTI. The rest of the contribution could go towards the cost of materials or labour.

The third and last condition: the final results must prove to be profitable for the players of the Swiss economy. Once again, concerning agriculture and the environment, it is clear that the projects of NCCR *Plant Survival* have something substantial to offer.

Please note that there is no minimum or maximum limit to the financing and the applications can be sent at any time. For a well defined project, one can expect an answer from the CTI three months after the date of reception.

For further information:
http://www.bbt.admin.ch/kti/f/main.htm (French)
http://www.bbt.admin.ch/kti/d/main.htm (German)

Forum

Desperately seeking coherence

Mr. Blaise Perret, wine-grower in Cormondrèche (NE), reflects on the get-together that took place between farmers, wine-growers and researchers of NCCR *Plant Survival*, which took place on April 9th at the University of Neuchâtel (see PS News no.3).

"Even though communication is possible between the scientific world and that of the growers, it seems to me that they are, nevertheless, two different worlds, in particular where the acquisition of knowledge is concerned.

The relationship between a grower and a researcher resembles that of a patient and a doctor: "I have a problem with my grapevine, give me a quick fix."

Faced with a multitude of technical solutions, often contradictory, and despite the successes achieved, the producer in the long run suffers from a lack of consistency. I get the impression that a number of farmers today are not really looking for a specific recipe, but rather a general orientation capable of providing a meaning and coherence to the daily choices that one must make. I believe that the interest in organic agriculture or biodynamic is testimony to such a lack.

As a wine-grower, I try to contribute to a plant's development and its potential. Potentials that are themselves attached to the potentials of the soil, climate, and a crop. However, the plant's life is not the goal in itself, growing grapevines is not a 'natural' act. It is rather entirely cultural, in other words geared towards the production of this eminently cultural drink called wine.

Seen from this angle, respect for the environment and an ecological balance are not an end in itself. It is important to control mildew not just for the sake of it, but because it decreases the quality of the grape. It is equally important to preserve soil health because that's what gives wine its richness. As far as the grapevine goes, I think that specialized research should find its coherence and its scientific relevance within a cultural space where the primary goal is research in quality.

The NCCR *Plant Survival* could, in fact, contribute to this need of coherence since you have the opportunity to work in a coordinated way between different projects.

Hence, I put forth the hypothesis that the global vision that you could derive from your research is more important than the specific applications that should come out of it."

Partners

FiBL: Science at the service of organic agriculture

Born out of an initiative of an association of organic farmers, the Research Institute on Organic Agriculture (FiBL) saw the day in 1973. Almost thirty years after its creation, its researchers published in the journal *Science a comparative study between organic and conventional agriculture. Impressive yields, a near-total elimination of pesticide use, and better soil quality are all arguments that give organic agriculture a very solid foundation.**

Out with the old prejudices. Organic agriculture, long considered as a non-profitable alternative, has this year revealed a completely different picture. According to a 21 year study directed by FiBL, in collaboration with the Federal Research Station in Agroecology and Agriculture in Zurich-Reckenholz (FAL), it seems that the yields of organic agriculture are only 20% less than that of conventional agriculture. Furthermore, it has the advantage of achieving substantial reductions in the need for plant nutrients such as nitrogen, phosphorus and potassium (from 34% to 51%). For the environment the gain speaks for itself: 97% reduction in volume of pesticide.

It is the first time that this type of comparative study is carried out for such a long period and it will continue until 2005. Baptized as DOK (German acronym for *bio-Dynamisch, bio-Organisch und Konventionell)*, it is taking place in Therwil, in the canton Baselland, on a field site available to the researchers since 1978. The research is comparing four types farming practices that differ primarily in the type of fertilizers used and the treatment employed. Two of these practices come from organic agriculture.

The first is a system widely used by organic farmers called 'bio-organic'. The second is cultivated according to the biodynamic precepts inspired by the anthroposophic philosophy of Rudolf Steiner. The other two trials reflect the methods used in conventional agriculture. One of them relies entirely on chemical fertilizers, while the second one adds farmyard manure to the chemical treatment. Since 1985, these last two field plots have been transformed in order to conform to the Swiss criteria for integrated agriculture.

Fertility stimulated

Obviously not all plants have achieved the same level of success. The trophy goes to wheat: the yields from the organic field plots were only 10% less than those from the conventional agriculture sites. As for organic potatoes, they achieved yields 60% to 70% of those from conventional practices. This difference can be explained by the low percentage of potassium present in the soil of the organic field sites and by a high incidence of the potato late blight, caused by *Phytophthora infestans*.

www.nationalgarden.com

"Soil fertility is clearly stimulated by organic agriculture", explains Paul Mäder, Group Leader Annual Crop Production at FiBL and the main person involved with this study. "The micro-organisms, the earthworms and the beneficial arthropods are almost twice as abundant in organic field plots." The importance of soil quality can be demonstrated by looking at clover, where the difference in yield between clover grown conventionally and biologically was minimal. These excellent results reflect the symbiotic relationship that the plant's root system enjoys with fungi and bacteria present in the soil such as mycorrhizae and *Rhyzobium* respectively. "Moreover, explain the researchers at FiBL, research in collaboration with the Botanical Institute of the University of Basel have shown that the density of mycorrhizae forming fungi is 40% greater in organic sites, hence improving the mineral uptake of plants."

Natural defenses present in the soil

Over and above the DOK study, the institute in Aargau is also interested in the soil's curative properties. In a recent research, one of the groups observed a correlation between a soil rich in microbial organisms and the resistance to diseases, such as in the tomato faced with *Phytophthora*. As for manure, it's a savior for cucumbers confronted with the fungus *Pythium ultimum* since it helps to stimulate the microbial activity thereby enabling the plant to resist this disease. In other words, the greater the increase in soil microbial activity, the more the micro-organisms colonize niches that would otherwise be occupied by *Pythium*, which in turn diminishes the occurrence of this pathogenic fungus.

By fueling the debate, the scientists at FiBL, much like the pioneers of organic agriculture, asked themselves if it was possible to go even further in plant protection.

They imagined a sort of vaccine for plants, which these specialists have dubbed 'induced resistance', where substances that are capable of stimulating the plants natural defense mechanisms have to be identified. Some of these substances are commercially available, but since they are produced by the chemical industry, the organic farmers refuse to adopt it. So, what is left then, is by natural means.

www.essex.nmsu.edu

Yields of conventional wheat are only 10% higher than that of organic wheat

A team from FiBL, led by Lucius Tamm, who is Head of the Plant research and Quality groups, is studying the properties of a resistance-inducing agent taken from *Penicillium chrysogenum*, in other words the fungus at the origin of penicillin. Known as PEN, this substance is a liquid compound extracted from the cell walls of the fungus. In the first phase, from 1997 to 2000, PEN was tested on tomatoes, cucumbers and grapevine. Its action includes a large spectrum of pathogens, decreasing the attacks from *Phytophthora infestans*, *Colletotrichum lagenarium* and *Uncinula necator*. Most remarkable was to observe an effect that PEN has against the downy mildew, *Plasmopara viticola*, while all other resistance-inducing agents are powerless against this disease.

"However, emphasizes Lucius Tamm, more time is required before PEN is used in practice. The type of mode of action first must be understood and the undesirable effects must, as much as possible, be eliminated, most importantly phytotoxicity. Not an easy task because the identification of the principle agent is very difficult in complex mixtures such as natural extracts." In this type of experiment the use of a model plant such as Arabidopsis is indispensable. It has enabled the researchers from FiBL to trace the signals by which PEN induces resistance to a disease.

*Paul Mäder et al., Science, vol. 296, pp. 1694-97, 31 May 2002

Assets in the laboratory and on the farm

As a partner of NCCR *Plant Survival,* FiBL distinguishes itself as a connoisseur in the world of agriculture. With thirty years of experience, this institute is more than a research centre. Employing 85 collaborators, it also forms consulting groups that regularly visit organic farms either to offer advice and to engage in discussions that deal with specific concerns or to experiment new measures destined to improving the quality of the harvest.

The areas of competence are vast. In the plant sector alone, there are no less than six sections working around themes related to plant production, protection against diseases and insects (biological control), and let's not forget the management of biota. The FiBL also offers its services in the quality control of organic products, comparing, for example, the taste of apples, tomatoes or carrots grown conventionally and organically.

The farm animals also represent a large area of interest for this institute in Aargau. Animal health specialists are currently searching for alternatives to antibiotics, which are too often administered in conventional livestock, while other colleagues are introducing an organic bovine breeding model in pasture, in order to guarantee a better quality of meat from the local butcher.

For more information:
www.fibl.ch
Research Institute on Organic Agriculture
Ackerstrasse
CH-5070 Frick

DOK- Hättenschwiler (FAC)

Experimental site in Therwil (BL)

Upcoming events

Graduate School annual meeting

November 29, 9:15 - 18:00 University of Neuchâtel
Do not forget to register.

Graduate School course

Genetically Modified Organisms (GMO) workshop

January 15-17, 2003

Introduction into Manuscript Review and Evaluation combined with a half-day Literature Search

February 7, 2003

Metabolism, growth and development

February 2003

For further details: www.unine.ch/nccr

Participant Meeting

"Pasture-woodlands/pâturages-boisés"

November 21, 2002
13:30 - 16:30
University of Neuchâtel, Uni Mail, Institut de chimie, room B1

NCCR *Plant Survival* projects (updated, autumn 2002)

Plant physiology

1a. Identification of genes involved in resistance of grape to grey mould *(Botrytis cinerea)* and downy mildew *(Plasmopara viticola)*
Head: Jean-Marc Neuhaus (Neuchâtel)

1b. Finding key regulators of induced resistance of plants to pathogens
Head: Jean-Pierre Métraux (Fribourg)

2. *Petunia* as a genetic model species for plant-pollinator interactions
Head: Cris Kuhlemeier (Bern)

3a. Plant defense mechanisms against biotic toxins
Head: Raffaele Tabacchi (Neuchâtel)

3b. Plastid function and plant survival
Head: Felix Kessler (Neuchâtel)

4. Plant nutrition under stress conditions: the combined role of nutrients, soil organic matter and root secretions
Head: Karl Föllmi (Neuchâtel)

Ecosystems

5. Microbial diversity in the rhizosphere of grapevine
Head: Geneviève Défago (ETH Zürich)

6. Pattern and long-term changes in pasture-woodlands: Complex plant-herbivore interactions in a traditional type of agro-forestry
Head: Christoph Scheidegger (WSL Birmensdorf)

7. The role of plants in the interactions between insect herbivores and their natural enemies
Head: Ted Turlings (Neuchâtel)

Application

8. Restoring biodiversity in agro-ecosystems: the role of seed origin for vegetation establishment, weed invasions and its biocontrol success
Head: Heinz Müller-Schärer (Fribourg)

9. Use of pheromones and kairomones for the control of moth pests in vineyards
Head: Patrick Guerin (Neuchâtel)

10. Resistance of grape to grey mould *(Botrytis cinerea)* and downy mildew *(Plasmopara viticola)*: its biochemistry and disease development
Head: Roger Pezet (Changins)

11. Consequences of introducing genetically modified plants into agroecosystems
Head: Franz Bigler (FAL, Reckenholz)

12. Statistical and dynamic modelling of plant survival in ecosystems
Head: Anthony Davison (EPF Lausanne)

PS News

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