CERCBET – a tool for the optimization of disease management in sugar beet

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INTRODUCTION

Cercospora leaf spot (*Cercospora beticola*) is the most serious fungal disease in German sugar beet growing. It may cause severe reduction in sugar beet yields and quality, and losses in sugar yield may vary from 5% to 50% depending on the severity of epidemics. Since the beginning of the 1990s, fungicide application has increased dramatically and, often, routine treatments were applied irrespective of disease development.

In order to reduce the number of superfluous fungicide applications, and to optimise fungicide use, a strategy based on action thresholds was elaborated. After certain improvements the strategy was introduced into practice by governmental crop protection services and sugar industry advisers. The action-threshold strategy required weekly assessments of 100 sugar beet leaves until the first treatment was applied; two weeks after the treatment assessments had to be continued. High labour input was the main reason for little acceptance by sugar beet growers. To enhance acceptance, the elaboration of forecasting models which should be able to predict the start of field assessments and the dates on which the action thresholds (disease incidences of 5, 15 and 45% during different periods from July to mid-September) are overridden was started. The main aim was to maximize the reduction of labour input for field assessments. If possible, the results of one or at maximum two assessments should be sufficient to serve as input for the models.

THE CERCBET MODELS

Development of the CERCBET models followed three main aims. The first two aims refer to the start of field assessments. Advisers from governmental crop protection services and from the sugar industry are the first to start monitoring activities. Their results are published via warning services (bulletins, internet). The first aim was to predict the start of these monitoring activities. Farmers commence their field inspections with a certain delay, so the second aim was to forecast the dates when farmers should start. For both aims a forecasting model was developed which predicts the date of first occurrence and the course of first occurrence in sugar beet fields, represented by a meteorological station. We named the model CERCBET 1. The third aim was to predict the dates when action thresholds (see above) will be exceeded and farmers should treat sugar beet crops with fungicides. To reach this aim a model (CERCBET 3) has been developed which simulates the progress of disease incidence for cercospora leaf spot. As the sugar beet growing season is quite long, and action thresholds may be overridden more than once, a module was needed within CERCBET 3 which models the effect of fungicides on the course of disease incidence.

As inputs, CERCBET 1 needs both meteorological and agronomical parameters. Temperature and relative humidity serve as meteorological input. Sugar beet prevalence, length of breaks between two successive sugar beet crops and an estimation of disease severities (in four classes) at the end of the previous season are the agronomic parameters and these represent a regional inoculum factor. CERCBET 1 calculates the share of sugar beet fields within a region infested by *C. beticola*. As soon as 5% of the sugar beet fields are infested (first occurrence) advisory officers should start regional monitoring activities. When about 50% of the fields are infested farmers should start observations in their own fields at the latest, because then the first action threshold for *C. beticola* control may be reached. Validation of CERCBET 1 was done with data sets from 1995 to 2003. In 12% of the cases CERCBET 1 predictions were too late and 21% of forecasts were too early, in regard to the date of regional first occurrence of *C. beticola*, considered a satisfying result. Far more important is a correct forecast of the date when 50% of the fields would be infested, because first fungicide treatments may already be required. In this case CERCBET 3 gave 89% correct forecasts. Just 7% of the predictions were too early and only 4% were too late.

CERCBET 1 is a model working on a regional scale whereas CERCBET 3 is plot-specific. Meteorological input parameters for CERCBET 3 are temperature, relative humidity, precipitation and wind speed. Agronomical input parameters are virtually the same as for CERCBET 1, but the parameter 'sugar beet prevalence' does not refer to the region in which the sugar beet field is located but to the close vicinity of the field. In addition, a factor representing irrigation is included in CERCBET 3. Epidemiology of *C. beticola* in CERCBET 3 is modelled by including three variables: incubation rate, infection rate and sporulation rate. These rates are combined multiplicatively to a daily infection pressure index from which disease incidence progress is calculated, using a logistic regression model. For modelling fungicide efficacy a module using temperature and precipitation and input parameters was included.

CERCBET 3 may be used to plan a fungicide strategy for a whole season, based on weather data, action threshold and one or two field assessments. CERCBET 3 in general gives good forecasts, in a range up to 50% disease incidence. Above 50% the model tends to underestimate disease incidences, which is not of practical relevance as the maximum threshold value is 45%. CERCBET 3 gave satisfactory results in 98 validation trials carried out from 2001 to 2003. The action threshold of 5% was correctly forecasted in 91% of cases, the 15% threshold in 83% and the 45% threshold in 81% of cases. Often, also, the 'too early' forecasts (9%, 13% and 10%, respectively) have to be considered as correct, owing to the very strong increase of the following epidemic. In order to improve CERCBET 3 forecasts, a module accounting for differences in cultivar susceptibility to *C. beticola* has recently been developed.

From 2003 to 2005, CERCBET 1 and 3 have been successfully introduced into agricultural practice on a national scale. The CERCBET models proved to be a valuable tool within an integrated crop protection system for sugar beet leaf disease control.

Models for beet rust (*Uromyces betae*), powdery mildew (*Erysiphe betae*) and ramularia leaf spot (*Ramularia beticola*) are currently under development.

Biosensors for field-based detection of plant pathogens and pesticide residue analysis: the state-of-the-art technology as a key tool in Integrated Plant Disease Management

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INTRODUCTION

In recent years there has been a rapid increase in the number of diagnostics applications in phytopathology and food chemistry based on biosensors, which can be defined as devices incorporating a biological sensing element connected to a transducer. The most advanced biosensor technology includes live, intact cells as the sensory units. At their current status, cell-based technologies could directly compete with immunoenzymic assays and other immunoanalytical systems. To these promising methods belongs the Bioelectric Recognition Assay (BERA) (Kintzios *et al.*, 2001). This method utilizes the natural response of cells to pathogens or other toxic factors. Alternatively, it can utilize so-called membrane-engineered cells, which are cells with tens of thousands of target-specific receptor molecules artificially inserted on the cell surface. In the following we describe, as a representative example, the application of BERA biosensors for the detection of (1) a plant virus (*Cucumber mosaic virus* – CMV) and (2) a pesticide (metamidophos) in plant tissues. Furthermore, we present the profile of a novel analytical lab, 3QLabs, which employs biosensors as an integral BMP tool for vegetable and fruit production at a country-wide scale.

METHODS

For CMV detection, BERA biosensors were based on membrane engineered Vero cells, created by electroinserting CMV polyclonal antibodies (Moschopoulou & Kintzios, 2006). For metamidophos detection, sensors were based on neuroblastoma cells. In both cases, each consumable sensor was connected to a working Ag/AgCl electrode and through this to the recording device, which comprised the PMD-1608FS A/D card (Measurement Computing, Middleboro, MA). Sensors were used for assaying CMV or metamidophos in homogenized plant extracts, derived from individual plants (n = 100). The total assay time was less than one minute. Result evaluation was assisted by a multi-net classifier system using Artificial Neural Networks (ANNs).

RESULTS

As demonstrated in Table 1, the BERA system was able to rapidly detect the presence of CMV or metamidiphos in plant extracts. Detection was very selective and each sensor type (membrane-engineered or neuroblastoma) responded only to its corresponding target (CMV or metamidophos, respectively). Further processing with the Artificial Neural Network has shown that the biosensor system was able to detect negative samples or samples positive for either CMV or metamidophos with 100% or 98% specificity, respectively.

Table 1. Response of BERA sensors to either CMV (membrane-engineered sensors) or metamidophos (neuroblastoma sensors) (n = 100 replications for each sample). Biosensor response is expressed in mV.

Biosensor type	Control	CMV	metamidophos	metamidophos
Membrane-engineered	27 ± 2	101 ± 11	27 ± 2	27 ±_2
Neuroblastoma	-5	-5	17	22

Furthermore, we conducted a market analysis for the feasibility of adopting the BERA technology as a routine method for pathogen testing and pesticide residue analysis. A model company, 3QLabs (www.3QLabs.org) was designed for this purpose. The analysis has shown that the company could achieve a net profit of 1.7 million € within five years of operations (Table 2).

Table 2. Financial assumptions and ratios for a model company employing biosensors as an integral BMP tool for vegetable and fruit production at a country-wide scale.

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales ('000 €)	500	930	1,770	2,090	2,900
Cost of goods ('000 €)	116	210	334	400	470
Profit before tax and interest ('000 €)	–	100	640	1,000	1,700

DISCUSSION AND CONCLUSIONS

Biosensor systems for field-based pathogen and pesticide residue detection offer a number of significant advantages, such as high speed, reproducibility, accuracy, selectivity and sensitivity, as well as the ability to monitor at real-time conditions and retrieve as much information as possible during a single assay. As revealed by the financial analysis, providing novel solutions for food quality assurance can be a very profitable business, especially in view of the new EU regulations for minimal residue concentration in marketed food.

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Introduction of GIS in decision support systems for plant protection

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INTRODUCTION

During the last 40 years many weather-based forecasting models have been developed for the control of late blight (*Phytophora infestans*) (Kleinhenz & Jörg, 2000). SIMPHYT I and SIMPHYT III have been established to provide the best control of late blight in Germany (Gutsche, 1999; Gutsche *et al.*, 1999; Roßberg *et al.*, 2001; Hansen *et al.*, 2002). SIMPHYT I predicts the first appearance and SIMPHYT III calculates the infection pressure for the disease. A new model class for late blight is in practical use – SIMBLIGHT1 (Kleinhenz, 2007). In future a combination of the forecasting models with Geographic Information Systems (GIS) should help to get better forecasting results for local areas between two or more meteorological (met.) stations. With the use of GIS, daily spatial risk maps will be created in which the spatial and the temporal process of first appearance and regional development of late blight are documented. To reach this aim it is necessary to prepare meteorological, geomorphologic and plot-specific parameters of the forecasting models with a spatial index.

METHODS

The building of spatial risk maps is done in six steps: Step 1: import of hourly met. data from the weather database. Step 2: combination of met. data with the geographic information of the met. station. Step 3: preparation of geographical baseline data. Step 4: interpolation of the met. data. Step 5: calculation of the forecasting model, using the results of the interpolation. Step 6: display of the results as a risk map. The first three steps deal with data management. Step four is the main and the most difficult step. Different kinds of interpolation methods are necessary to identify or modify a method which gives the best results in interpolating met. data. Step five uses the interpolated met. data as input parameters to calculate the forecasting models. The final step is to connect the results to an internet application in which spatial information is displayed as a risk map of the first appearance of late blight and, later, of the daily infection risk.

RESULTS

The first calculations showed that deterministic interpolation methods were not suitable. We therefore concentrated on geostatistical interpolation methods. The following results show a comparison between Kriging (K) and Multiple Regression (MR) methods. Temperature and relative humidity were calculated for the years 2000 to 2005 for two German Bundesländer (Brandenburg and Rheinland-Pfalz). To compare the measured data with interpolated data some met. stations have been left out of the interpolation process. After calculation the interpolated values were compared with the measured values of the met. stations. Both interpolation methods were able to calculate results with high accuracy. The coefficient of determination in all cases ranged from 96 to 99%. The results showed no significant differences between the two interpolation methods in either Bundesland. The differences between K values and measured values ranged from 0.5 to 2°C. Differences were less for MR (0.3 to 1°C). The interpolation of relative humidity (RH) show similar results compared with temperature interpolation. The coefficient of determination varied from 92 to 96% and mean differences in RH were 5 to 10% of recorded values.

After met. data, interpolation with MR data was made available to the forecasting models. The model predicted that infection of late blight would start early in the north-western part of the area and spread to southeast. Two monitoring points (P1 and P2) are displayed on a map, and field records from these monitoring points used to verify the calculation results. Infections at P1 (in the area at maximum risk) were recorded earlier than at P2 (in the low-risk area). The recorded time difference of the first occurrence of late blight at P1 and P2 was 14 days, which coincides well with our calculations. Absolute differences of forecasted and recorded dates for first occurrence of late blight were 3 days, which must be regarded as a highly accurate result.

CONCLUSION

The combination of forecasting models with analyses and methods from GIS is a milestone for advising farmers. GIS methods and analyses will help to obtain more detailed information, and results will have greater validity than before. It will be easier to understand and to interpret the results of forecasting models. Spatial maps will show hot spots of maximum risk. GIS and forecasting models lead to easier control of late blight. Thus, the aim of reducing the number of sprays can be achieved and this guarantees an environmentally friendly and economic crop-protection strategy. The clear vivid presentation methods of GIS make decision support system results easier to understand and lead to a higher acceptance of warning systems by the farmers.

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The forecaster ZWIPERO for downy mildew of onion: applying a disease warning system in diverse culture systems of vegetable crops

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INTRODUCTION

Downy mildew of onion, caused by *Peronospora destructor*, is the most disastrous disease on leaves of onion in all onion-growing regions with a humid climate. Therefore, forecasting systems based on weather data have been developed for spring-sown onions and adjusted to the regional conditions in several countries (Canada, France and Italy and the Netherlands).

In Germany, the forecaster ZWIPERO (Friedrich *et al.*, 2003) was introduced for spring-sown onions in 2005. Furthermore, depending on the climatic conditions, onions are grown as an over-wintering crop and as all-year-grown salad or bunching onions, with very high regional importance. In order to meet different market demands, spring-sown and salad onions vary widely in variety, the canopy density chosen and the irrigation intensity applied. While in bulb onion production severe downy mildew epidemics affect the yield and the grading achieved, in salad onions even low disease incidence, as well as pesticide residues, result in an unmarketable crop. Therefore, the forecaster ZWIPERO has been adjusted with regard to the diverse culture systems.

METHODS

The forecasting model ZWIPERO determines the risk of sporulation and infection of downy mildew, based on simulated microclimatic input data. Such data are provided by the subroutine AMBETI (Braden, 1995), the soil-plant-atmosphere model of the German weather service (DWD). Input data of the subroutine are actual standard weather data and hourly-predicted weather data, as well as data from local model fields (soil type, plant density, seeding date, canopy development and calculated irrigation time). Field trials were conducted in spring-sown onions (2000–2004) and salad and over-wintering onions (2005–2006) at the experimental farm in Queckbrunnerhof (DLR-Rheinpfalz) as well as at commercial farms. The trials included: (i) determination of canopy development (green leaf area index); (ii) variety tests; (iii) validation of fungicide strategies according to daily ZWIPERO output data; and (iv) monitoring of sporulation periods as an estimation of the regional inoculum available.

RESULTS

Canopy development differed strongly among the different culture systems and, to some extent, among different onion varieties. To take this into account the development of green leaf area was determined as a function of leaf stage (onions for bulb production) or canopy height (salad onions) and provided as an additional subroutine to AMBETI. The currently available varieties are all susceptible to downy mildew, with some varieties showing partial resistance. On average, two sprays fewer than in the grower routine were applied when using ZWIPERO to determine fungicide application in experimental field trials and on farm trials in spring-sown onions. The experimental trials also indicated an increasing fungicide efficacy when using the predicted infection risk values to determine fungicide application. Additionally, the sporulation risk values may be used as an efficient tool for assessing sporulation and disease incidence in commercial fields.

ZWIPERO is provided by ISIP via the internet (**i**nformation **s**ystem **i**ntegrated **p**lant production: www.isip.de) in cooperation with the advisory services of the various Länder in Germany. The advisory services supply data from local model fields and communicate ZWIPERO information to the growers. Alternatively, growers have directly internet access to ZWIPERO forecast of their specific region.

DISCUSSION AND CONCLUSION

The forecaster ZWIPERO for downy mildew in onion was adapted for diverse culture systems, such as all-year-grown salad onions or spring-sown and over-wintering onion crops. ZWIPERO is a proven tool to increase fungicide efficacy by timed fungicide sprays according to predicted infection risk. It may also lead to a reduction in the number of fungicide sprays and, therefore, contributes to the national pesticide reduction programme. In 2005 and 2006, ZWIPERO was provided, for spring-sown onions, via the internet and was universally accepted by advisory services and growers. The implementation of ZWIPERO for salad onions in the information system ISIP will be continued in 2007.

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The phytosanitary strategies for control of plant-parasitic nematodes in the Ukraine

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INTRODUCTION

The introduction and spread of plant-parasitic nematodes depend to a great extent on the phytosanitary legislation employed. The Ukrainian General State Inspection on Plant Quarantine is issuing a number of new actions to improve statutory regulations, and the importance of plant-parasitic nematodes as a constraint to crop production in the Ukraine has recently been recognized (Movchan *et al*., 2004). For the first time, a new national list of quarantine and regulated plant-parasitic nematodes has been prepared on the basis of technical justification and pest risk analysis. The latter revealed the necessity to collect and analyze information on the detection of phytonematodes in export and import commodities.

METHODS

The results of nematological diagnostics conducted in 24 quarantine laboratories of the Ukraine were submitted to one database, within which statistical data were grouped into different categories (nematodes: systematic order, feeding type; commodities: type, place of origin, import / export / local trading etc.). Statistical analysis of the data was made following these categories.

RESULTS

During the years 2004–2005, 146,730 nematological analyses were carried out in quarantine laboratories, of which 30,773 were conducted for commodities imported from 19 countries. In total, 60 nematode species were detected in a broad range of quarantine samples: 28 species were identified in potted plants, 13 in commercial turf, 9 in sawn coniferous timber, logs and wooden packaging materials, 7 in seedlings, 6 in bulbs and 5 in potato. The orders Araeolaimida, Dorylaimida, Enoplida, Monhysterida, Rhabditida and Tylenchida were represented by 1, 6, 4, 1, 24 and 24 species, respectively. No species rated as a ‘quarantine pest not present in the Ukraine’ were found.

A larger number of nematode species (78) were found in commodities specified for local trading or export from the Ukraine: of these, 8 species were identified in potted plants, 28 in soil samples, 34 in sawn coniferous timber, logs and wooden packaging materials, 9 in seedlings, 5 in bulbs and 17 in potato. The orders Araeolaimida, Dorylaimida, Enoplida, Rhabditida and Tylenchida were represented by 1, 2, 30 and 42 species, respectively.

DISCUSSION AND CONCLUSIONS

Nematological diagnostics conducted for the imported commodities proved at potted plants were the main pathway for plant-parasitic nematodes to enter the Ukraine. Further, identification of nematode species detected in the commodities specified for local trading or export from the Ukraine improved knowledge of nematode fauna associated with different environmental sites in the Ukraine. The latter revealed, for example, that sixteen species of *Heterodera* were present in the country (*H. avenae*, *H. cacti*, *H. carotae*, *H. cruciferae*, *H. estonica*, *H. galeopsidis*, *H. goettingiana*, *H. humuli*, *H. leptonepia*, *H. millefolii*, *H. paratrifolii*, *H. punctata*, *H. rumicis*, *H. schachtii*, *H. trifolii* and *H. urticae*). However, further studies are necessary to prove the identifications, that were based on morphological characteristics.

Detection of other nematode species, more or less common in Ukrainian agriculture, included those in the genera *Aphelenchoides*, *Ditylenchus* and *Meloidogyne*. Further, *Bursaphelenchus mucronatus* was detected several times in sawn coniferous timber and logs.

All this information was submitted to the pest (nematode) risk assessment programme, which finalized the preparation of a new Ukrainian national list of regulated plant-parasitic nematodes.

In contrast with the current list, which includes seven nematode species, the new one will include twelve: here, there will be an attempt to use official regulations not only for quarantine nematode species (*Bursaphelenchus xylophilus*, *Globodera pallida*, *G. rostochiensis*, *Heterodera glycines*, *Meloidogyne chitwoodi*, *M. fallax* and *Nacobbus aberrans*) but also regulated non-quarantine species which could be spread by mean of seeds, seedlings and other planting material (*Aphelenchoides besseyi*, *Ditylenchus destructor*, *D. dipsaci*, *Radopholus citrophilus* and *R. similis*).

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FOOTPRINT – functional tools for pesticide risk assessment and management

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INTRODUCTION

FOOTPRINT (www.eu-footprint.org) is a 3-year research project in the EU 6th Framework Programme (Project No. 022704). FOOTPRINT aims at developing a suite of three pesticide risk prediction and management tools, for use by three different end-user communities: farmers and extension advisors at the farm scale, water managers and local authorities at the catchment scale, and policy makers and registration authorities at the national/EU scale.
The tools will be based on state-of-the-art knowledge of processes, factors and landscape attributes influencing pesticide fate in the environment and will allow users:

- to identify the dominant pathways and sources of pesticide contamination in the landscape;
- to estimate levels of pesticide concentrations in local groundwater resources and surface water;
- to make assessments of how the implementation of mitigation strategies would reduce pesticide contamination of adjacent water resources.

The three FOOTPRINT tools will be complementary and tailored to the different needs of the different user groups. They share the same philosophy and underlying science (e.g. the development and subsequent modelling of a large number of scenarios representing agro-environmental conditions in the EU) and will provide a coherent and integrated solution to pesticide risk assessment and management in the EU. The predictive reliability and usability of the tools will be assessed through a substantial programme of piloting and evaluation studies at the field, farm, catchment and national scales. Beta-versions of the three tools will be publicly available for testing in September 2007; the final versions are due in November 2008.

THE FOOT-FS (FARM SCALE) TOOL

FOOT-FS is mainly targeted at farmers and extension advisors. It will be available both as a stand-alone application and as a web portal. The aims of the tool are:

- to identify the pathways and those areas that most contribute to contamination of water resources by pesticides at the scale of the farm;
- to provide site-specific recommendations to limit transfers of pesticides in the local agricultural landscape.

The classification of the agricultural land according to the pathways leading to contamination of water resources by pesticides will be based on a hybrid between the CORPEN and HOST methodologies. The estimation of pesticide concentrations in water resources due to leaching, drainage and surface runoff/erosion will rely on the deterministic models MACRO and PRZM, while simpler, more pragmatic approaches (e.g. drift calculation formulae according to FOCUS) will be used for assessing pesticide inputs via spray drift and point sources (storage places, farmyards). Predicted concentrations in edge-of-field surface water bodies will allow risk assessments to be performed for aquatic taxa as all three FOOTPRINT tools will include a database of ecotoxicological threshold values for fish, invertebrates, higher aquatic plants and algae.

THE FOOT-CRS (CATCHMENT AND REGIONAL SCALE) TOOL

FOOT-CRS is mainly targeted at local authorities, stewardship managers and water managers in charge of implementing the WFD and/or limiting the contamination of water resources by pesticides. However, it may also have applications with regulators or the crop protection industry, e.g. to investigate a region more closely when an application of the national and EU-scale tool FOOT-NES has identified this region as a potential 'hot spot' of pesticide exposure. FOOT-CRS will be available as an ArcGIS extension. The main objectives of the FOOT-CRS tool are:

- to identify those areas in a catchment that most contribute to pollution of waters by pesticides;
- to define and/or optimise action plans (monitoring, mitigation, application restrictions etc.) at the scale of the catchment.

The classification of the agricultural land according to the dominant pathways leading to pesticide contamination of water resources will be based on remote sensing data (satellite imagery or aerial photos) and an adaptation of the HOST/CORPEN methodology used in the farm-scale tool FOOT-FS.

THE FOOT-NES (NATIONAL AND EU SCALE) TOOL

FOOT-NES is mainly targeted at decision and policy makers, but also has relevance to the registration context. The tool will have the potential to support the pesticide registration authorities and the crop protection industry for higher-tier modelling purposes. FOOT-NES will be available as an ArcGIS extension. The main objectives of the FOOT-NES tool are:

- to identify the areas or regions in the EU or a member state that are most at risk from pesticide contamination;
- to assess the probability of pesticide concentrations exceeding legal or ecotoxicologically-based thresholds.

Exposure/risk assessment in FOOT-NES is, thus, exclusively prospective. For risk assessment for the current situation, the user is referred to the two smaller-scale tools. In FOOT-NES, the classification of the European agricultural land according to the dominant transfer pathways will be undertaken using the innovative, data-parsimonious IDPR methodology.

ENDURE – a European network of excellence on pesticide reliance reduction

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INTRODUCTION

ENDURE is an initiative to reshape European research and development on pesticide use in crops, for the implementation of sustainable pest control strategies. It was selected for funding by the European Commission in response to call FP6, Food Quality and Safety, in the Area 'Safer and environmentally friendly production methods and technologies and healthier food stuffs' and Topic 'Reducing the use of plant protection products (NoE)'.

The consortium is made up of partners from 10 European countries:

- INRA (ENDURE Coordinator) – France;
- Association de Coordination Technique Agricole (ACTA) – France;
- CIRAD – France;
- INRA Transfert (IT) – France;
- International Biocontrol Manufacturers' Association IBMA – International;
- Consiglio Nazionale delle Ricerche CNR (Italy);
- Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna (SSSUP) – (Italy)
- Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA) – Germany;
- Rothamsted Research (RRES) – UK;
- Aarhus University, Faculty of Agricultural Sciences (FAS) – Denmark;
- Danish Agricultural Advisory Service (DAAS) – Denmark;
- Agroscope Swiss Federal Research Station (AGROS) – Switzerland;
- Plant Breeding and Acclimatization Institute (IHAR) – Poland;
- Szent István University (SZIE) Hungary;
- Universitat de Lleida (UdL) – Spain;
- Plant Research International (PRI) (also representing PPO and LEI of Wageningen UR) – the Netherlands.

Our objective is to reshape European research and development on pesticide use in crops, and to establish the network as a leader in the development and implementation of sustainable pest management strategies.

We will create a coordinated structure that takes advantage of alternative technologies, builds on advances in agricultural sciences, ecology, behaviour, genetics, economics and social sciences, and connects researchers to other stakeholders in extension, industry, policy-making and civil society. This multi-disciplinary and cross-sector approach is designed to foster the development and implementation of strategies rationalising and reducing pesticide inputs, as well as reducing risks.

Our operational goals are:

- to bring together research capacity and resources currently fragmented across Europe. We will share knowledge and people, and pool our facilities, biological resources and equipment through a joint crop protection research programme and the creation of a coordinated and geographically decentralised European resource facility – a 'virtual laboratory' – on pest control;

- to enhance the research-to-R&D innovation process by creating working relationships between researchers and practitioners in extension services and farming;

- to bring in industry, policy-makers and civil society to help define the research agenda;

- to pass on knowledge, know-how and resources through training, education and dissemination, targeting farmers, advisors, researchers, policy-makers and civil society – our European Pest Control Competence Centre is designed to become a source of knowledge and expertise, to support public policy-makers, regulatory bodies, extension services and other crop protection stakeholders;

- to endure, by building a sustainable, coherent and transnational institution made up of leading European crop protection research, R&D, extension, and industry organizations.

We will advance toward these goals in three ways:

- integrating activities that will help us identify priority research areas, link up with other relevant research and civil society groups, and plan our legal and financial sustainability;

- jointly executing research that will stimulate and develop a culture of collaboration in areas that are key to achieving progress in reducing reliance on pesticides;

- cross-fertilisation (or spreading) that will extend our activities and outputs to farmers, extension agents, students, policy-makers, consumers and society-at-large, as well as to elicit feedback and dialogue, ensuring that activities and outputs meet the needs of these stakeholders.

Our four-year programme started in January 2007. The initial 18-month period – with funding spread over a large number of participants and activities to foster interaction and sharing – will serve to review and collate research, and will lead to a focused research programme shaped by competitive bids in priority areas for collaborative projects submitted by at least three partners from three countries.