**SCIENTIFIC COMMITTEE
OF THE BELGIAN FEDERAL AGENCY FOR THE SAFETY
OF THE FOOD CHAIN**

ADVICE 10-2011

Subject: Development of a plant health barometer (phytosanitary situation) (Dossier SciCom 2009/09 ter)

Advice validated by the Scientific Committee on 26 September 2011

Summary

The aim of this advice is to present an instrument to measure the overall phytosanitary situation of plants and plant products in Belgium on a yearly basis and to monitor its evolution over time. This instrument is, alongside the food safety barometer (Advice 28-2010) and the animal health barometer (Advice 09-2011), one of the 3 instruments available to provide a bird's eye view on the overall status of the safety of the food chain in Belgium.

In order to measure the plant health situation, working with a battery of indicators is proposed, the composition of which may change over time. Quantitative data must be available for these indicators. In total, 13 plant health indicators (PHI's) were identified and the results of these were monitored between 2007 and 2010.

Based on the results of the 13 plant health indicators, it is apparent that plant health (phytosanitary situation) in Belgium has shown a positive development since 2007, the real meaning of which must be assessed over the long term.

Lastly, a proposal for the visual presentation of the plant health barometer has been developed.

Key words

Indicators - Barometer - Plant Health – Phytosanitary situation - Food chain

1. Terms of Reference

1.1. Question

This dossier was started following a request made by the Advisory Committee of the Federal Agency for the Safety of the Food Chain (FASFC or food agency) in regard to the identification of a number of indicators that can be used to measure the impact of the current FASFC food safety policy.

This dossier also links up with one of the objectives in the Business Plan drawn up by the Chief Executive Officer of the FASFC (Houins, 2009), in the sense that an instrument needs to be developed for the measurement and follow-up of the food safety evolution: a barometer for measuring safety within the food chain.

1.2. Scope

The dossier on the development of barometers to measure the safety of the food chain encompasses the **safety of the entire food chain** (from farm to fork). This means that both the safety of foodstuffs (food safety) and the animal and plant health status are taken into consideration.

The barometer of the safety of the food chain will thus be composed of three partial aspects: the “food safety” barometer, the "animal health" barometer and the "plant health" barometer.

In the meantime, the food safety barometer was introduced by the FASFC on 17 November 2010 during the International Symposium on ‘*Measuring Food Safety and comparing self checking systems’* based on advice 28-2010 of the Scientific Committee.

This dossier mainly focuses on the development of the concept with regard to measuring and monitoring the overall phytosanitary situation (national) of plants and plant products.

As previously mentioned, a decision was taken to restrict the scope of the plant health barometer to the absence of harmful quarantine organisms only (= harmful organisms regulated under the Law of 2 April 1971 on the control of organisms harmful to plants and plant products). The term “plant health” does therefore not cover the absence of non-regulated harmful organisms, namely the agents responsible for endemic diseases such as late blight, fusarium infection and rust etc. This term neither covers abiotic diseases such as those caused by the lack or excess of water, or of trace elements, or caused by the excess of salt or by frost.

Consequently, a decision was also taken not to use data sourced from agricultural warning systems or statistics on the use of pesticides as a potential indicator. Both of these data sources are focussed mainly on endemic diseases (= diseases caused by the presence of harmful non-quarantine organisms).

A number of food crises that occurred in the 1990s (e.g. the BSE-crisis and the dioxin crisis) have shown that ensuring food safety can best be achieved by using a chain approach, whereby all respective stakeholders within the food chain bear their own responsibility for food safety as a whole. In Belgium, such an approach was first initiated by the FASFC, which was created in pursuance of the Law of 4 February 2000 (BS 18/02/2000). In creating a barometer of the safety of the food chain, it is clearly not the intention to develop an instrument for the assessment of the functioning of the FASFC itself. This study aims to develop a method to measure plant health (phytosanitary situation) on a national level and on a yearly basis and must be situated within the scope of the expectations of society with regard to the competence of the FASFC for safeguarding the safety of food on the one hand, and animal and plant health, on the other.

1.3. Definitions

As in advice 28-2010, sound working definitions are essential.

In this dossier, the following definitions are used:

- **Food chain**: any and all possible stages of the chain
  - during the course of the breeding and keeping of animals and the growing of crops, starting from the biological material and all necessary raw materials or resources,
  - during the course of the production of foodstuffs and animal feed, from the stage of raw material production up to the stage of consumption.

- **Safety of the food chain**: the general sanitary status of the food chain with regard to biological, chemical or physical hazards (including animal and plant health), for which all respective segments within the food chain bear their own responsibility, ensuring that safe food is offered to the consumer (i.e. without the hazardous presence of biological, chemical or physical agents, and also taking into account the circumstances under which the product is normally being used by the consumer and the information that is available for the foodstuffs concerned).

- **Food safety**: the condition of the foodstuffs at all stages of production, processing and distribution, required to guarantee the protection of consumer health, and also taking into account normal circumstances of use and information available for the foodstuffs concerned.

  Food safety thus means the absence of biological, chemical or physical agents (hazards) in the foodstuffs concerned (EC regulation n° 178/2002).

- **Food safety policy**: a set of dynamic initiatives (preventive and corrective) taken by the government over the entire food chain, with the intention of achieving a high-grade sanitary status for plants and animals and offering safe food to the consumer.

- **Indicator**: a measure for rendering and analysing certain problems or issues. An indicator synthesises or simplifies relevant data about the status or evolution of a number of phenomena or symptoms. An indicator represents a reality that is in itself not entirely perceptible. It is an indicator that is intended for communication and support in the decision-making process, and it can assume either a quantitative (cardinal) or a qualitative (nominal or ordinal) form. (In accordance with Indicators, goals and visions of sustainable development' - Federal Report on sustainable development, 2009).

- **Animal health**: general health situation of the livestock population.

- **Plant health**: overall phytosanitary situation of plants and plant products, i.e. the absence of regulated harmful organisms in accordance with the Law of 2 April 1971 on the control of organisms harmful to plants and plant products.

- **Plant Health Indicator (PHI):** an indicator that provides broad-scoped information about the overall plant health situation (phytosanitary situation). The Plant Health Indicator is not a performance indicator, in the sense that it is not being used for evaluating the performance level of a certain (set of) activities, as is often done in a management context where the goals have been clearly set. The term Plant Health Indicator does not necessarily provide an assessment of the actual performance of any given activity.

- **Barometer for the safety of the food chain**: a visual rendering of the safety of the food chain, consisting of a food safety barometer, an animal health barometer and a plant health barometer.

- **Plant health barometer (phytosanitary situation):** an instrument based on several Plant Health Indicators, used for providing a visually attractive representation of the overall phytosanitary situation of plants and plant products on a national level.

- **Key Activity**: an activity that forms part of the food chain and represents a considerable production volume, and/or may have a considerable impact on the food chain safety and indirectly on plant health because of the very nature of the activity.

After due deliberation during the work group meetings on 23 March 2010, 26 April 2010, 29 June 2010, 23 September 2010 and 15 March 2011 and the plenary sessions that took place on 18 June 2010, 15 October 2010, 19 November 2010, 27 May 2011 and 16 September 2011,

the Scientific Committee recommends as follows:

2. Introduction

The idea of a barometer to measure the safety of the food chain must be viewed within the context of the prevailing trend towards measurable objectives, indicators, assessments, score systems and the like. This idea is also being inspired by the introduction of similar notions in other sectors, such as the inter-federal poverty barometer[1] and the sustainability barometer (Sustainable Development Task Force, 2009).

The barometer of the status and the safety of the food chain consists of several parts, namely:
- a food safety barometer (safety status of foodstuffs);
- an animal health barometer;
- a plant health barometer.

These barometers are not aimed at providing an exact and complete image of all possible hazards and risks within the food chain. They rather serve as an instrument for communication and trend analysis with regard to the safety status of the food chain, intended towards a broader public and/or to the respective stakeholders in the food chain. Therefore, its intention does not involve drawing up a comprehensive scientific report giving an exact image of the presence and status of all potential dangers within the food chain, nor is it intended to carry out any form of risk assessment.

The barometers must be seen as a practical instrument giving a mere **indication** of the safety status within the food chain (on food safety, animal health and plant health levels), as based on measurements obtained through a limited number of carefully selected indicators which relate to the respective hazards and partial aspects of the food chain, and which, as a whole, will provide a representative image of the actual situation. The selection of the indicators, as well as a number of related assumptions for the plant health barometer (phytosanitary situation) are further discussed below.

3. Work method

3.1. Development of a research method

In order to be able to identify which indicators are suited to determine plant health (phytosanitary situation) in a well-substantiated way, a research method was developed, consisting of several steps.

[1] (http://enquete.mi-is.be/armoedebarometer/pages_fr/startMenu.html)

3.1.1. Step 1: Defining the research area

Despite the fact that the notions of "food safety", "animal health" and "plant health" are well integrated in our society, it is apparent that accurate definitions for these notions are lacking, both in the broad literature as in national and European legal reference documents. The drawing up of accurate definitions and interpretations of the scope has thus constituted an important step in this process (see above).

3.1.2. Step 2: Identification of the policy objectives with regard to plant health

At the time the FASFC was created, the expectations regarding the organisation of the food chain control system were clearly defined (Law of 4 February 2000). This control system was meant to cover the entire food chain, from the point of view of protecting public health, animal health and plant health, as well as implementing basic principles, such as transparency, co-operation, consultation, scientific support, self-checking, pro-activity and responsiveness, implementation of risk analysis and of the precautionary principle, as well as the quality, integrity and independence of services offered.

As far as the set goals for plant health, animal health and food safety are concerned, much has yet to be clarified: the descriptions or specifications don't go any further than a mere "guarantee for a permanent high quality of our food" and "the high and continuous protection of plant and animal health".

It has been found that the policy objectives regarding plant health are not quantitatively described neither in national or European documents. The bases of the phytosanitary policy are however laid down at European level through Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community. The overall objective of this directive was to prevent the introduction and control the spread of organisms harmful to plants and plant products in the European Union. This phytosanitary regime was recently subject to an in-depth evaluation (FCEC, 2010). Following this evaluation, specific recommendations included further prevention measures to further prioritise risks and to further improve solidarity between Member States. An adaptation of the European phytosanitary regime should be released during 2012. In Belgium, the phytosanitary policy is modelled on the European legislation on these matters (Royal Decree of 10 August 2005 on the control of organisms harmful to plants and plant products).

3.1.3. Step 3: The selection of a scientifically substantiated concept: the "Pressure-State-Response" concept and its implementation on the food chain

The development of the food chain safety barometer was based on the Pressure-State-Response' (PSR) concept, which serves as a starting point for establishing the research model. The PSR concept was used in the 1980s by the OECD for the classification of environmental indicators into three different categories: pressure (P), status (S), and response (R) (OECD framework for environmental indicators; Van Gerven et al., 2007). The PSR concept is based on the principle of causal relationship, occurring when human activities exert a pressure on the system, thereby causing a change in the status (or 'state') of said system. Society must react to these changes and will ultimately have to take decisions ('response').

The Pressure-State-Response' concept is described in further detail in advice 28-2010. It will not be elaborated on in any more detail in this advice. It should however be recognised that this concept also applies to the determination of plant health (phytosanitary situation) and the understanding of its developments.

3.2. Developing a measurement system for Pressure-State-Response

A measuring system is needed to determine the Pressure, the Status (or 'State') and the Response. As the 3 components of the PSR-model each stand for a different aspect of the safety of the food chain, it is not possible to develop one single measuring system for all three

components. As a consequence, specific measuring systems were established for pressure, status and response. It was decided that **the final barometer should only consist of 'Status' and that 'Pressure' and 'Response' would be used to give a further interpretation to 'Status' within a broader social and policy-related context**. The final barometer consists of 3 partial aspects, namely food safety, animal health and plant health, and will be measured using a range of indicators. The 'Pressure' and 'Response' will be charted by means of an inquiry among stakeholders. Figure 1 illustrates the implementation of the PSR-model on the safety of the food chain.

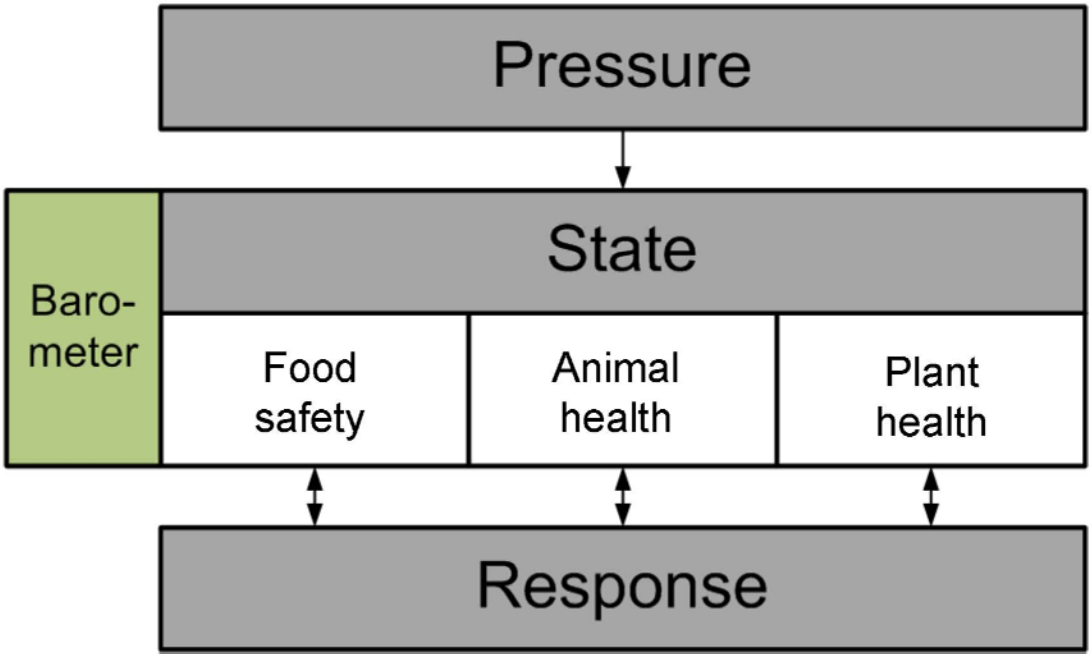

Figure 1: Implementation of the Pressure-State-Response model on food chain safety

3.2.1. 'Pressure' Measurement

See advice 28-2010.

3.2.2. 'Status' Measurement

As mentioned previously, food chain safety can be split up into 3 partial aspects, namely food safety, animal health and plant health. As the specific status of each of these three partial aspects may be of a very divergent nature, and in view of their importance to the respective stakeholders, a decision was taken to measure each of these 3 partial aspects separately.

Numerous controls and inspections are being conducted by the FASFC, in order to monitor plant health (phytosanitary situation). If all the results of these controls and inspections were to be incorporated into this measuring instrument, this would only lead to an unworkable instrument, and would pass beyond the objectives of using 'indicators'. Furthermore, an overview of most of these measurement data is publicly available in the annual reports of the FASFC or other authorities, institutions or organisations.

In pursuance of the health index[2], 3 batteries of indicators representative of the state of food safety, animal health and plant health were selected. An indicator provides information about a partial aspect of the status. The indicators are basically descriptive in nature, and are not

[2] http://economie.fgov.be/fr/statistiques/chiffres/economie/prix_consommation/indice_sante/qu_est-ce_que_indice_sante/

intended for checking any data against any set goals. Their real goal is to achieve a trend analysis of the overall situation over the longer term, both in terms of the individual indicators and in terms of the barometer itself (across all indicators).

The exact composition of the battery of indicators is therefore of major importance. Hence it is also clear that this battery of indicators cannot encompass all aspects of plant health on its own. It is self-evident that each indicator will have its own limitations. The composition of this battery of indicators may be modified from time to time, whenever it is apparent that some indicators are no longer representative, or whenever other indicators appear to better reflect the actual situation as a result of new developments.

The concept of using a battery of indicators inherently implies that choices must be made as to the definitions of these indicators. A number of criteria have been established for the selection of carefully considered indicators:

- **Measurability**: The actual goal of status measurement is to find out whether overall food safety, animal health or plant health have improved, deteriorated or remained the same. That is why indicators were selected that are measurable on a quantitative data basis and that are also capable of rendering evolutionary trends over certain periods of time.

- **Independence**: It is recommended that the indicators should not overlap each other.

- **Reliability**: The indicators must not be sensitive to any bias (deviations).

- **Availability**: The information required for the indicator must at all times be easily available in existing reports, documents or databanks. Only results that were collected in the context of the control programme will be used for product control purposes.

- **Representative for food safety, animal health or plant health.**

- **Representative for the food chain**: The set of indicators must be representative for the entire chain giving specific attention to the various sectors for which international trade and intracommunity trade must be taken into account.

- **Unambiguity of the wording**: There must be an unambiguous relationship between a modification of the indicator and the modification of food safety, animal health or plant health.

- **Sustainability**: The indicators have been measured in a similar manner over several years already, and it is expected that they will be further followed up during many years to come.

Case study: Plant health barometer (phytosanitary situation)

Based on the above-mentioned criteria, a battery consisting of 13 different indicators has been composed (table 1). This battery of indicators includes:

- the entire plant production chain, namely: the suppliers, primary production, distribution/trade, the propagating of plants, the processing of plants (e.g. wood packaging materials, cut flowers etc.), forests and green spaces;
- the various types of plants and plant products: fruit, vegetables, potatoes, cereals, ornamental plants (including trees), plants/seeds, cut flowers, wood packaging;
- process control (inspections/audits);
- a preventive approach (self-checking/mandatory notification/traceability).

Table 1 provides an overview of the 13 plant health indicators. For each indicator, a detailed technical data sheet was drawn up, which can be found in Appendix 1.

Table 1: Overview of the plant health indicators.

Title	Description
PHI1: Mandatory notification of plant diseases and harmful organisms	The number of notifications received by the FASFC each year with regards to the detection of plant diseases and harmful organisms (excluding control plan).
PHI2: Self-checking for plant production	The percentage of annual key activities performed (see appendix 4) with a validated/certified self-checking system (SCS) in the plant production sector.
PHI3: Phytosanitary inspections (physical checks)	The percentage of annual phytosanitary inspections that were deemed to be favourable or favourable, subject to remarks.
PHI4: Phytosanitary inspections (traceability)	The percentage of annual phytosanitary inspections relating to traceability that were deemed to be favourable or favourable, subject to remarks.
PHI5: Harmful organisms regulated and detected in Belgium	The percentage of regulated harmful organisms for which at least one sample is tested positive per year in Belgium in relation to the total number of regulated harmful organisms.
PHI6: Phytosanitary import controls	The percentage of samples of plant and plant product consignments, imported into the EU via the Belgian border inspection posts, which are compliant with the phytosanitary requirements.
PHI7: *Bursaphelenchus xylophilus* (Pine wood nematode)	The annual percentage of compliant results in relation to the control of pine wood nematode (*Bursaphelenchus xylophilus)* within the framework of the FASFC control plan.
PHI8: *Meloidogyne chitwoodi* and/or *M. fallax* (Root-knot nematodes)	The annual percentage of compliant results with respect to the control of root-knot nematodes (*Meloidogyne chitwoodi* and/or *M. fallax*) within the framework of the FASFC control plan.
PHI9: *Globodera rostochiensis* and/or *G. pallida* (Cyst nematodes)	The annual percentage of compliant results with respect to the control of cyst nematodes (*Globodera rostochiensis* and/or *G. pallida*) within the framework of the FASFC control plan.
PHI10: *Ralstonia solanacearum* and/or *Clavibacter michiganensis* subsp. *sepedonicus* (Potato brown rot and/or ring rot)	The annual percentage of compliant results with respect to the control of potato brown rot and/or ring rot (*Ralstonia solanacearum* and/or *Clavibacter michiganensis* subsp. *sepedonicus*) within the framework of the FASFC control plan.
PHI11: *Pospiviroidae*	The annual percentage of compliant results in relation to the control of *pospiviroidae* within the framework of the FASFC control plan.
PHI12: *Diabrotica virgifera* Le Conte (Corn rootworm)	The annual percentage of compliant samples tested for corn rootworm (*Diabrotica virgifera* Le Conte) within the framework of the FASFC control plan.
PHI13: *Phytophthora ramorum* (Sudden oak death)	The annual percentage of compliant samples tested for sudden oak death (*Phytophthora ramorum*) within the framework of the FASFC control plan.

For the purpose of verifying whether or not the whole set of plant health (phytosanitary situation) indicators is representative for the entire plant production chain, a Plant Health Indicator Matrix has been established (Appendix 2). This matrix shows the relationship of the different Plant Health Indicators with the respective segments of the plant production chain. A summarised illustration of this is also presented in table 2.

Table 2: Overview of the number of Plant Health Indicators that are related to the different segments of the plant production chain.

Plant production chain segment	Number of Plant Health Indicators
Suppliers	5
Primary plant production	12
Processing	6
Distribution	11
Green spaces/forests	5
Imports	10

Appendix 3 provides an overview of the types of plant production to which the plant health indicators (phytosanitary situation) relate. A summarised illustration of this is also presented in table 3.

Table 3: Overview of the number of Plant Health Indicators that are related to the different types of plant production.

Plant production type	Number of Plant Health Indicators
Agricultural supply (fertilisers, soil conditioners etc.)	6
Cereals	8
Forage crops, industrial crops, corn	8
Potatoes	10
Market gardening	9
Fruit crops	6
Horticulture, Nurseries, Green spaces	10

The indicators measure and reflect the different aspects of the general phytosanitary situation of plants and plant products and are based on preventive measures, control actions and on plant health (phytosanitary situation). These preventive measures for safeguarding plant health include the setting up and implementation of plant health management systems (namely self-checking, based on good working practices, and mandatory notification). The control actions involve infrastructure control, traceability, disease notification and the quality control of plants and plant products (analyses).

Each indicator has its own strengths and weaknesses, as explained in the technical sheets in Appendix 1. In this respect, it is important to take into account the context within which the indicators were defined. The identified "plant health indicators" must constitute the basis of a plant health barometer (phytosanitary situation). The goal is to introduce a systematic operating procedure based on this "barometer" in order to enable the monitoring of the plant health situation, in a way that is accessible to a broader public.

In this context, certain indicators or indicator groups should be interpreted as follows:

For example, it should be noted that the first six identified indicators (PHI1 to PHI6) are ‘generic” as each of them relate to almost any plant or plant product, whereas the seven other indicators (PHI7 to PHI13 inclusive) are more specific, as they apply to a number of specific plants or plant products (e.g.: potatoes, corn crops etc.).

As regards the mandatory notification of plant diseases and harmful organisms (PHI1), it is clear that an increase in the number of reports may possibly be due to the introduction of infectious diseases or may be the result of a higher degree of alertness (whether or not stimulated by media campaigns), leading to a greater degree of vigilance. Given that mandatory notification is an inherent part of the preventive approach, and is also essential for

preventing the spread of plant diseases, an increase of the number of reported cases therefore indicates in this context a substantial degree of vigilance with regard to the safeguarding of plant health. In this regard, it is recommended that plant production chain operators are better trained in recognising the symptoms caused by the presence of harmful quarantine organisms (= regulated harmful organisms in accordance with the Law of 2 April 1971 on the control of organisms harmful to plants and plant products).

As for the presence of a validated/certified self-checking system (PHI2), it should be noted that the operators may freely choose whether or not they want to have their self-checking system validated. Attention should however be drawn here to the fact that in case of absence of a validated self-checking system for a key activity, it does not mean that the self-checking system is absent or malfunctioning. The point is that an independently validated self-checking system provides added value and adds to the confidence as to the foundations and functioning of such system. An increase of the percentage of key activities with a validated self-checking system thus indirectly leads to a higher confidence level with regard to adequate preventive actions taken in order to ensure overall plant health.

As regards the results of the inspections (PH3 to PHI4 inclusive), any changes that may be made to the evaluation system from time to time (e.g.: new checklists) must be taken into account. This may result in year-to-year differences with regard to the detection of non-conformities. It is however recommended that, in the event of significant changes to the evaluation system, both the sector and the authorities make great efforts in raising awareness, informing and assisting the concerned operators, with a view to applying and limiting the non-conformities to a new evaluation system. This is why, for some indicators, one must also take into account the fact that some inspections may have been aimed at high-risk production sites, products or countries of origin as a result of which some degree of bias may be involved. This is however a systematic bias that is inherent to the development of a control system based on risk.

As regards PHI5 (Harmful organisms regulated and detected in Belgium), it is worth noting that the composition of the list of harmful regulated organisms varies according to changes in the Belgian and European legislation on this matter. Moreover, this indicator does not cover the detection of regulated harmful organisms at import level given that these statistics are included under PHI6 (phytosanitary import controls). In PHI5, harmful organisms that are exclusively regulated for the protected areas within the EU are not covered (namely those listed under parts B of the royal decree of 10 August 2005). Moreover, the harmful organisms listed in the Royal Decree of 19 November 1987 for which no active control policy has been conducted are not covered either.

As regards the phytosanitary import controls (PHI6), it should be clarified that certain samples are taken at random, whereas others are taken solely on the basis of the visual observation of symptoms or systematically (e.g.: as a requirement of European legislation).

The seven specific indicators (PHI7 to PHI13 inclusive) were selected to cover the maximum segments of the plant and plant product production sector (e.g.: trees and wood products, potatoes, cereals, vegetables, ornamental plants) and to cover the various types of harmful organisms (e.g.: bacteria, insects, nematodes, viroids, mould). The aim of some of these indicators is to identify the possible emergence of a risk (e.g.: *Bursaphelenchus xylophilus*) or the possible reemergence of a risk (e.g.: *Diabrotica virgifera*). It should be noted that there is no specific indicator for fruit production, but the organisms harmful to this type of production are indeed covered by the generic indicators. It should also be noted that there are several specific indicators for the potato sector, on the same principle that this sector is targeted by the European phytosanitary regime.

Results and presentation

As indicated in the technical sheets (Appendix 1), data were gathered for the Plant Health Indicators for the years 2007, 2008, 2009 and 2010. Table 4 gives an overview of the Plant Health Indicators for which data were available.

Table 4: Overview of the results for 2007, 2008, 2009 and 2010 of the respective Plant Health Indicators (the number of samples or inspections is shown between brackets) and significance level (* = p < 0.05, ** = P < 0.01, *** P < 0.001) when comparing between two consecutive years.

	Results for 2007	Results for 2008	Results for 2009	Results for 2010	% Change (2008/2007)[1]	Significance level	% Change (2009/2008)[2]	Significance level	% Change (2010/2009)[3]	Significance level
PHI1	12	43	23	25	258.33%	[9]	-46.51%	[9]	8.70%	[9]
PHI2	12.12	18.96	30.97	42.76	56.44%	***	63.34%	***	38.07%	***
PHI3	94.6	95.2	95.3	96.4	0.63%		0.11%		1.15%	*
PHI4	94	96.2	95.6	98	2.34%	*	-0.62%		2.51%	**
PHI5	5.45	6.39	6.64	6.64	-17.25%[5]		-3.91%[5]		0.00%[5]	
PHI6	83.84	77.51	8.57	87.2	-7.55%	*	10.40%	**	1.90%	
PHI7	100	100	100	100	0.00%		0.00%		0.00%	
PHI8	-[4]	99.47	100	100	-		0.53%		0.00%	
PHI9	99.87[6]	99.4	99.16	99.07	-0.47%	*	-0.24%		-0.09%	
PHI10	100	100	99.95	100	0.00%		-0.05%		0.05%	
PHI11	73	97.1	99.3	67	33.01%	***	2.27%		-32.53%	***
PHI12	100	100	100	100	0.00%		0.00%		0.00%	
PHI13	81	78.3	75.8	91.6	-3.33%		-3.19%		20.84%	***
Globally					26.85%[7]		1.70%[8]		3.12%[8]	

[1] % Change = (2008 result – 2007 result)/2007 result x 100%.
[2] % Change = (2009 result – 2008 result)/2008 result x 100%.
[3] % Change = (2010 result – 2009 result)/2009 result x 100%.
[4] Result not available.
[5] The sign of this indicator was changed since a decrease of this indicator actually shows an improvement in plant health.
[6] Based solely on regional statistics.
[7] Average of 12 indicators (= PHI8 excluded, cf. [4]).
[8] Average of 13 indicators.
[9] Undeterminable using the Poisson regression model.

The majority of the PHIs (PHI3 to 4 and PHI6 to 13) are expressed as a percentage of compliant samples or as a percentage of inspections that were given a 'favourable' opinion or 'favourable, subject to remarks'. These indicators show the extent to which the operators or plant or plant products have met the legal requirements.

From the results (cf. table 4), it is immediately clear that a significant number of indicators (7 indicators out of 10 in 2010) score very high results in regard to compliance (> 95 %), **which suggests that there is a high level of plant health (phytosanitary situation) in Belgium.**

Next, using a Poisson regression, it was checked whether the observed changes (comparison of 2008 versus 2007, comparison of 2009 versus 2008, comparison of 2010 versus 2009) were to be considered to be incidental or statistically significant.

This analysis seems to demonstrate that plant health (phytosanitary situation) in its entirety has improved over the 2007-2010 period (successive improvements of 26.85 %, 1.70 % and 3.12 % respectively between 2007 and 2008, 2008 and 2009, and 2009 and 2010).

Table 5 provides an overview of the indicators that have shown significant variations ($p < 0.001$) over the 2007-2010 period.

Table 5: Overview of the indicators that have shown highly significant variations ($p < 0.001$) over the 2007-2010 period.

2008/2007	2009/2008	2010/2009
PHI2 (+ 56.44 %)	PHI2 (+ 63.34 %)	PHI2 (+38.07%)
PHI11 (+ 33.01 %)		PHI13 (+ 20.84 %)
		PHI11 (- 32.53 %)

As regards the mandatory notification of plant diseases and harmful organisms (PHI1), there was a marked increase in 2008 compared with 2007 due to higher numbers of fireblight notifications (cf. table 4). This is explained, on one hand, by an increased vigilance after an intensive information campaign in the province of West Flanders on fireblight and, on the other hand, by a higher number of outbreaks resulting from favourable weather conditions. Both elements have led to an increase in notifications which is considered, in the barometer, as a positive evolution as it allows to take appropriate mitigation actions. Given that this indicator is not expressed in relation to other variables, it was not possible to carry out a statistical analysis of the results for the various years using the Poisson regression model.
A steady and highly significant improvement was observed ($p < 0.001$) of the situation in relation to self-checking at plant production level (PHI2) during the 2007-2010 period.
In general PHI11 (*Pospiviroidae*) has only shown slight changes between 2007 and 2010 (highly significant improvement ($p < 0.001$) between 2007 and 2008 but a highly significant deterioration ($p < 0.001$) between 2009 and 2010. This result must however be put into perspective bearing in mind that in 2009, the statistics were increasingly favourable but relating solely to the *Potato spindle tuber viroid* (*PSTVd*), whereas from 2010 they related to all pospiviroidae.
In general PHI6 (Phytosanitary import controls) has only shown slight changes between 2007 and 2010 (significant deterioration ($p < 0.022$) between 2007 and 2008 but a highly significant improvement ($p < 0.007$) between 2008 and 2009).
The situation relating to phytosanitary inspections (physical controls, PHI3), phytosanitary inspections (traceability, PHI4) and to *Phytophthora ramorum* (Sudden oak death, PHI13) improved generally during the 2007-2010 period (significant improvement ($p = 0.030$) for PHI3 between 2009 and 2010, significant improvements ($p = 0.044$) and very significant ($p = 0.02$) for PHI4 respectively between 2007 and 2008, and between 2009 and 2010, and very high significant improvement ($p < 0.001$) for PHI3 between 2009 and 2010).

On the other hand, as regards *Globodera rostochiensis* and/or *G. pallida* (Cyst nematodes, PHI9), the situation deteriorated overall during the 2007-2010 period (significant deterioration (p = 0.010) of PHI9 between 2007 and 2008). This result must however be put into perspective, bearing in mind that this indicator, for 2007, was solely calculated on the basis of regional statistics.

Figures 2, 3 and 4 provide a visual representation of the results obtained.

As for the proposed processing of results, **no weighting of indicators has been included**, as a result of which each indicator will have a similar impact on the barometer. As previously mentioned, when viewed from society's standpoint, the definition of the concept of 'Plant health (phytosanitary situation)' is not as unambiguous as it seems: the impact of the various indicators on plant health may be perceived in a different way by different individuals or stakeholders. It is possible that one and the same change, when applied to several indicators, may result in different impacts on plant health. For example, the impact on plant health of a 20 % increase of PHI10 (*Ralstonia solanacearum* and/or *Clavibacter michiganensis* subsp. *sepedonicus (*Potato brown rot and/or ring rot) could be greater than a 20 % decrease of PHI1 (mandatory notification of plant diseases and harmful organisms). As previously mentioned, the primary goal of the barometer is to conduct a measurement and trend analysis of the 'Plant health' situation on the basis of indicators that are directly or indirectly related to the monitoring and ensuring of plant health throughout the entire plant production chain, rather than conducting a comprehensive plant health measurement. In order to get a proper insight into the degree of importance attached to certain indicators by the various stakeholders and experts, a weighting of the indicators has been proposed using the Las Vegas method (Gore, 1987) with the purpose of determining the relative importance of the indicators as a measure of plant health.

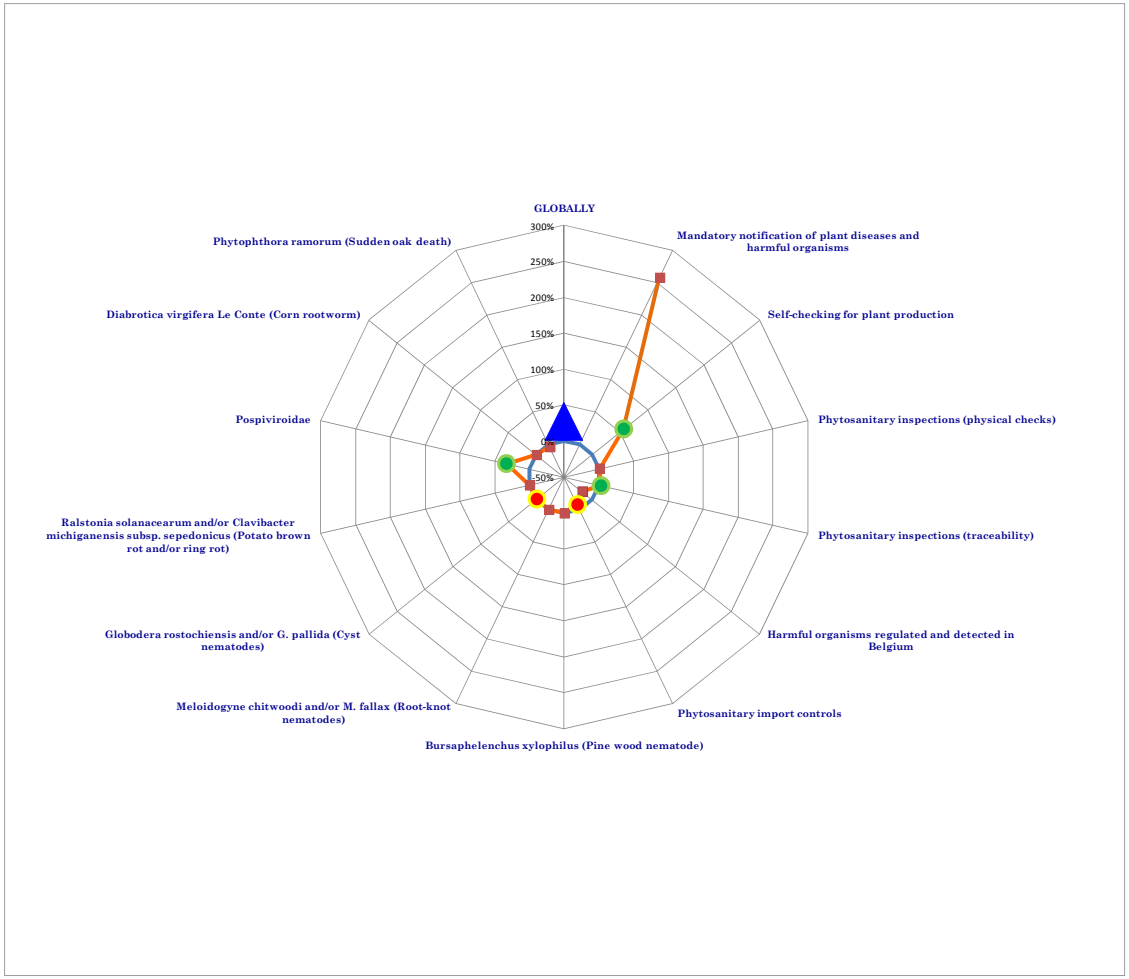

Figure 2: Visual representation of the plant health barometer (phytosanitary situation): difference between the years 2007 and 2008 expressed as a percentage. ▲: overall plant health; ●: significant improvement of the plant health indicator; ●: significant deterioration of the plant health indicator; blue line: status quo.

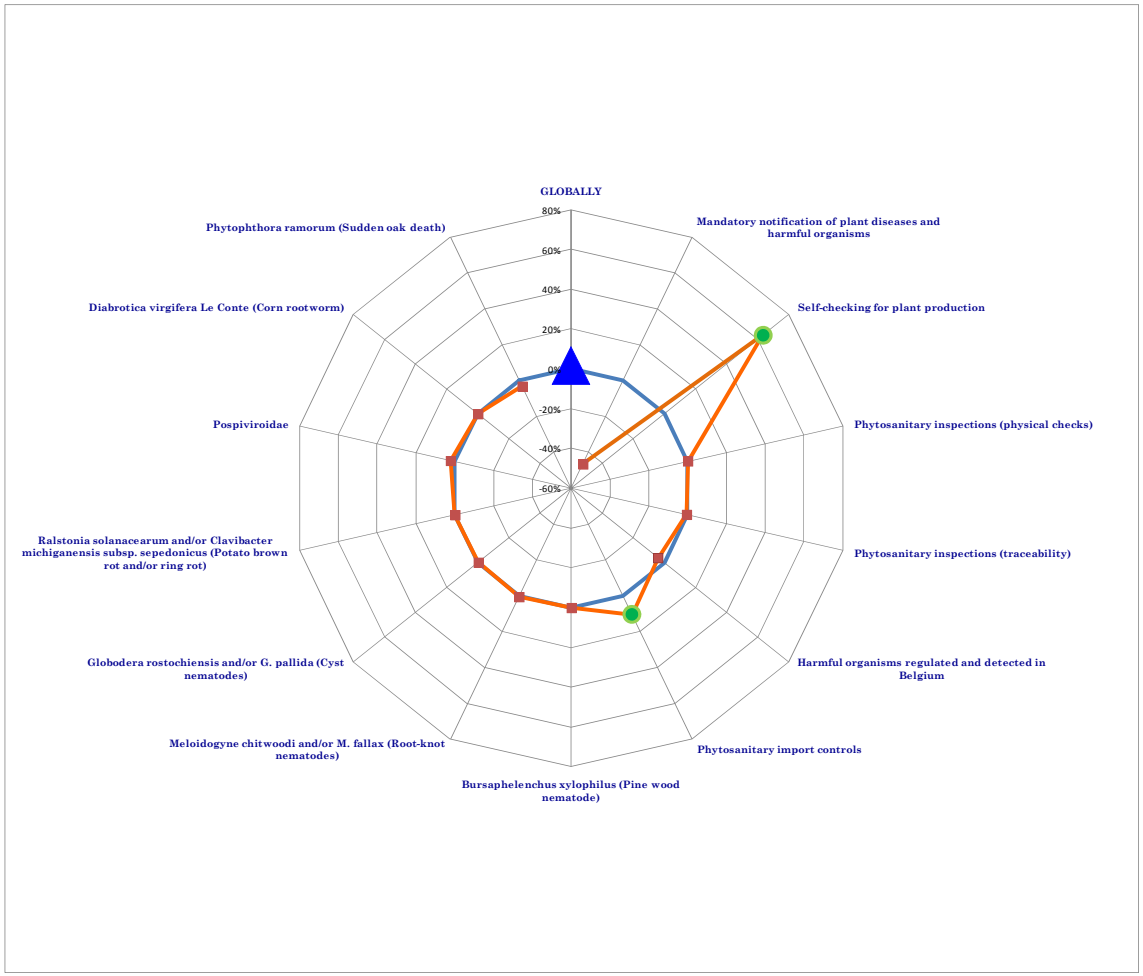

Figure 3: Visual representation of the plant health barometer (phytosanitary situation): difference between the years 2008 and 2009 expressed as a percentage. ▲: overall plant health; ●: significant improvement of the plant health indicator; ●: significant deterioration of the plant health indicator; blue line: status quo.

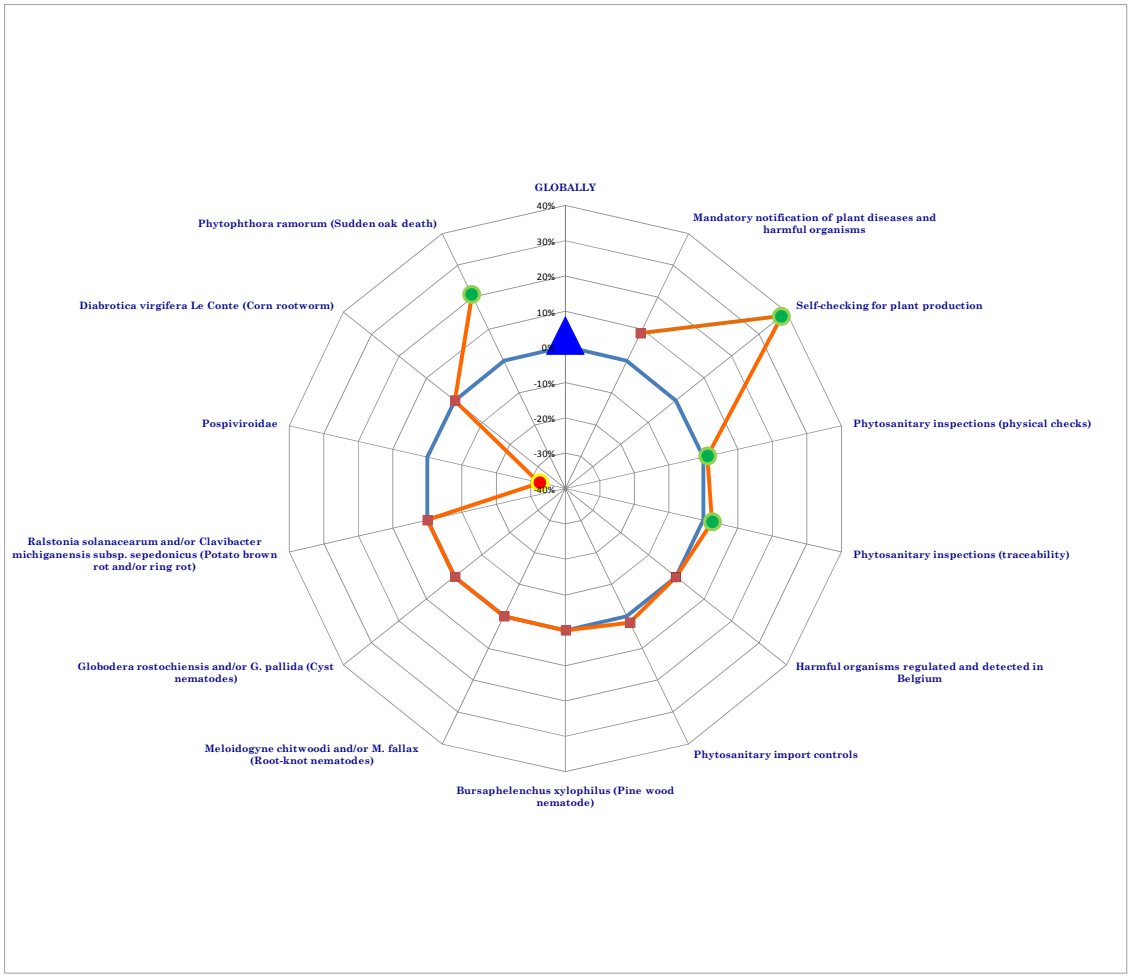

Figure 4: Visual representation of the plant health barometer (phytosanitary situation): difference between the years 2009 and 2010 expressed as a percentage. ▲: overall plant health; ●: significant improvement of the plant health indicator; ●: significant deterioration of the plant health indicator; blue line: status quo.

3.2.3. 'Response' Measurement

See advice 28-2010.

4. Conclusion

The aim of this dossier is to present an instrument to measure the overall phytosanitary situation of plants and plant products in Belgium on a yearly basis and to monitor its evolution over time. This instrument is, alongside the food safety barometer (Advice 28-2010) and the animal health barometer (Advice 09-2011), one of the 3 instruments to provide a bird's eye view on the overall status of the food chain in Belgium.

In order to measure the plant health situation (phytosanitary situation), working with a battery of indicators is proposed, the composition of which may change over time. Quantitative data must be available for these indicators. In total, 13 plant health indicators (PHI's) were identified and the results of these were monitored between 2007 and 2010.

Based on the results of the 13 indicators of the plant health barometer, it is apparent that plant health (phytosanitary situation) in Belgium has shown a positive evolution since 2007, the real meaning of which must be assessed over the long term.

As regards the mandatory notification of plant diseases and harmful organisms (PHI1), it is recommended that plant production chain operators are better trained in recognising the symptoms caused by the presence of harmful quarantine organisms (= regulated harmful organisms in accordance with the Law of 2 April 1971 on the control of organisms harmful to plants and plant products).

With regard to the plant health situation, the Scientific Committee has been confronted with the difficulty regarding the composition of a representative battery of indicators without including all of the potential risks that might occur. It is thus equally apparent that each indicator has its own strengths and weaknesses, and that the whole set of indicators is representative for plant health in general, but does not encompass each and every aspect of plant health.

The plant health indicators included in the barometer mutually differ in their direct relationship with the measurement of actual plant health. The Scientific Committee recommends to carry out a weighting of the perceived importance of the indicators with the stakeholders and experts with regard to plant health.

Furthermore, a regular evaluation of the set of indicators will be required, in order to check whether new indicators must be included or existing indicators need to be withdrawn.

The Scientific Committee came to the conclusion that the policy goals regarding plant health (phytosanitary situation) were not quantitatively defined, neither in national documents, nor in European documents. If more measurable goals were to be made available for specific points of interest, a further objective assessment with regard to the improvement of plant health would be simplified.

On behalf of the Scientific Committee,
The President

Prof. Dr. Ir. Andre Huyghebaert
Brussels, 10 October 2011

Appendices

Appendix 1: Technical sheets of the plant health indicators (phytosanitary situation).
Appendix 2: Matrix of plant health indicators by sector
Appendix 3: Matrix of plant health indicators by plant production type
Appendix 4: Overview of key activities

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Incompatibilities

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Legal framework of this advice

The Law of 4 February 2000, on the establishment of the Federal Agency for the Safety of the Food Chain, and in particular article 8 of said Law;

The Royal Decree of 19 May 2000, on the structure and operating procedures of the Scientific Committee, as established within the Federal Agency for the Safety of the Food Chain;

The Internal Rules as mentioned in Article 3 of the Royal Decree of 19 May 2000, on the composition and operating procedures of the Scientific Committee established within the Federal Agency for the Safety of the Food Chain, as approved by the Minister on 9 June 2011.

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