ANNEX 7

GENERAL SURVEILLANCE OF AMFLORA POTATOES USING A FARM QUESTIONNAIRE

BioMath

APPLIED STATISTICS AND INFORMATICS
IN LIFE SCIENCES

General surveillance of Amflora potatoes using a farm questionnaire

Biometrical report for the 2011 planting season

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Summary

EH92-527-1 potato (variety Amflora) is a starch potato with increased amylopectin content in the tuber starch for which BASF Plant Science had submitted a notification for placing on the market according to Directive 2001/18/EC [4]. In March 2010, following Commission Decision 2010/135/EU [8], the Swedish Board of Agriculture issued the consent for cultivating amylopectin potato EH92-527-1 in the European Union. The consent requires the implementation of the Amflora monitoring plan comprising General Surveillance (GS), Case-Specific Monitoring and the Identity Preservation (IP) system.

In the 2011 growing season, Amflora potato was cultivated commercially at locations in Sweden and Germany for seed potato production. To meet the requirements of GS, as part of the IP system general observations were made throughout the vegetation period on cultivation practices, general characteristics of Amflora, its susceptibility to pests and diseases, its growth and development as well as the occurrence of wildlife, and captured in the format of a farm questionnaire. A total of five farm questionnaires addressing the different monitoring characters were collected from all growers participating in the IP system for cultivation of Amflora potato, and analyzed.

An evaluation of the monitoring characters that were rated $as\ usual$ or were deviating from what is in general observed for potato cultivation by the growers allowed the following conclusions. For most characters Amflora performed as any conventional potato variety (e.g. sprouting, plant growth, time to emergence, agronomic characteristics, success of weed, pest or disease control, presence of wildlife). The deviations (later harvest, lower yield) were clearly a consequence of adverse weather conditions and other influencing factors, and none of them were considered as adverse effects.

Chapter 1

Introduction

Post-market monitoring of genetically modified plants under cultivation is mandatory in the EU. According to Annex VII of Directive 2001/18/EC [4] of the European Parliament and of the Council on the deliberate release into the environment of genetically modified plants, the objective of the monitoring is to:

- confirm that any assumption regarding the occurrence and impact of potential adverse effects of the GMO or its use in the environmental risk assessment are correct, and
- identify the occurrence of adverse effects of the GMO or its use on human health or the environment, which were not anticipated in the environmental risk assessment.

For EH92-527-1 potato (variety Amflora) the consent issued by the Swedish Board of Agriculture following Commission Decision 2010/135/EU [8] requires the implementation of the Amflora monitoring plan comprising General Surveillance (GS), Case-Specific Monitoring and the Identity Preservation (IP) system.

The objective of this biometrical report is to present the results of the analysis of the monitoring data on GS that were collected for the 2011 Amflora growing season via the Amflora farm questionnaire.

Chapter 2

Methodology

The aim of General Surveillance (GS) is to identify potential adverse effects of cultivating Amflora potatoes that were not identified during the pre-market risk assessment. The risk assessment and GS relate to the conservation of protection goals such as biodiversity, sustainable agriculture, plant, human and animal health as well as soil function.

From the protection goals and the outcome of the pre-market risk assessment several monitoring characters that might be influenced by the cultivation of Amflora were derived. In GS data on these monitoring characters are collected. Additionally data on several other influencing factors like environmental conditions, agronomic measures or field specific characteristics are collected to separate their influence from the possible effect of genetic modification.

2.1 Definition of monitoring characters

The main focus of the tools for GS is the survey of several monitoring characters that were derived from protection goals. Table 2.1 provides an overview on the monitored characters and the protection goals that are addressed.

Table 2.1: Monitoring characters and corresponding protection goals

Monitoring characters	**Protection goals**
Sprouting	Plant health
Time to emergence	Plant health
Plant growth	Plant health, soil function
Phenotype	Plant health, soil function
Weed pressure	Sustainable agriculture, soil function, biodiversity
Success of weed control	Sustainable agriculture, soil function
Occurrence of pests	Plant health, biodiversity
Pest susceptibility	Plant health
Success of pest control	Sustainable agriculture
Occurrence of disease	Plant health
Disease susceptibility	Plant health
Late blight pressure	Sustainable agriculture, soil function, biodiversity
Success of late blight control	Sustainable agriculture
Success of disease control	Sustainable agriculture
Maturity	Sustainable agriculture, plant health
Date of harvest	Sustainable agriculture, plant health
Yield	Sustainable agriculture, soil function
Presence of wild animals	Biodiversity
Additional observations	All

Note: only the main corresponding protection goals are listed. However, each of the monitoring characters is addressing most of the protection goals, e.g.: all the characters that concur to demonstrate the agronomic equivalence of Amflora to conventional potatoes are addressing impact on biodiversity.

The data for the monitoring characters were surveyed on a qualitative scale by asking farmers for their assessment of the Amflora potato cultivation compared to the cultivation of conventional starch potatoes. For most questions, three possible categories of answers were given: $As\ usual$, $Plus$ (e.g. delayed, better, more) or $Minus$ (e.g. accelerated, poorer or less) (see Table 2.2). Mention of $Minus$ or $Plus$ implies no valuation, it is used to define the direction of the difference.

Table 2.2: Monitoring characters and their categories

Monitoring characters - observations of Amflora	$Minus$	$As\ usual$	$Plus$
Sprouting	Poorer	As usual	Better
Time to emergence	Accelerated	As usual	Delayed
Plant growth	Accelerated	As usual	Delayed
Phenotype		As usual	Different
Weed pressure	Less	As usual	More
Success of weed control	Poorer	As usual	Better
Occurrence of pests	Fewer	As usual	More
Pest susceptibility	Less	As usual	More
Success of pest control	Poorer	As usual	Better
Occurrence of disease	Fewer	As usual	More
Disease susceptibility	Less	As usual	More
Late blight pressure	Less	As usual	More
Success of late blight control	Poorer	As usual	Better
Success of disease control	Poorer	As usual	Better
Maturity	Accelerated	As usual	Delayed
Date of harvest	Accelerated	As usual	Delayed
Yield	Less	As usual	More
Presence of wild animals	Less	As usual	More

2.2 Definition of influencing factors

Additionally, several possible influencing factors were surveyed to assess the local cultivation and environmental conditions and to determine causes of potential effects relating to the monitoring characters other than genetic modification (Table 2.3).

Table 2.3: Monitored influencing factors

Type	**Factor**
Site	Soil quality rating, humus content, soil type, results of soil test, soil fertility, rainfall, temperature, soil temperature during planting
Cultivation	Crop rotation (inter crop), tillage, seed category, quality and quantity, planting method, date of planting and forming ridges, irrigation, fertilization, use of herbicides, insecticides and fungicides, pest, disease and weed control measures, haulm killing and harvest

2.3 The farm questionnaire

The farm questionnaire as a tool for GS was first developed in a pilot study by the German Federal Biological Research Center for Agriculture and Forestry (BBA, now JKI), maize breeders and statisticians (Schmidt *et al.* 2008 [10]). A revised version of the original farm questionnaire is used for GS of GM maize cultivation in Europe. The farm questionnaire for maize was adapted for the purpose of GS relating to the cultivation of of Amflora potatoes under an IP system, tested and improved in a three-year period prior to the first commercial cultivation of Amflora potatoes in 2010.

The questionnaire consists of five parts for collecting monitoring characters, influencing factors and other background data. The sections of the questionnaire are:

0 Personal details
1 Farm
2 Location
  2.1 Soil
  2.2 Weather
3 Cultivation measures
  3.1 Cultivation, beginning after harvest of preceding crop
  3.2 Data relating to seed potatoes
  3.3 Planting / Cultivation / Development
  3.4 Fertilization
  3.5 Chemical weed control
  3.6 Occurrence of pests / treatment
  3.7 Occurrence of disease / treatment
  3.8 Use of herbicides for haulm killing
  3.9 Harvest
4 Presence of wild animals
5 Additional comments

Section 1 records general, basic data of the field as size of the farm, cultivation area and which potato varieties were cultivated. Section 2 summarizes data about location, the soil and weather in the region of cultivation. Section 3 collects data on Amflora cultivation practices and observations. In nine subsections the farmer is asked about crop rotation, planting, growth and development of Amflora, irrigation, fertilization, weed, disease and pest occurrence and control, harvest and yield. In Section 4 the farmer is asked to answer a question on the occurrence of wildlife. In Section 5 the farmer can provide comments on additional observations.

In Section 3 and 4 monitoring characters (see table 2.1) as well as influencing factors (see table 2.3) are collected. Questions on monitoring characters are formulated in such a way that farmers give their assessment on the behavior of the GM potato compared to conventional (starch) potatoes, and therefore with three possible answers ($Plus$/ $As\ usual$/ $Minus$). The $Plus$ and $Minus$ answers indicate a deviation from experiences in cultivation of conventional (starch) potatoes. Each $Plus$ or $Minus$ assessment must be provided with an explanation for this assessment. High frequencies ($> 10\%$ of answers from all farmers for respective question) of $Plus$ or $Minus$ answers would

indicate possible effects.

2.3.1 Coding of personal data

In each questionnaire the personal details were coded according to the following format:

1	9	-	S	T	-	A	M	-	2	0	1	0	-	C	Z	-	0	1	-	0	1
Event Code			Crop Code			Variety Code			Year Code					Country Code			Farmer code			Area Code	

Codes:

Event: 19 BPS-25271-9

Crop: ST *Solanum tuberosum*

Variety: AM Amflora

Country: SE Sweden
DE Germany

Farmer: ascending counter for farmers within the country

Area: ascending counter within the farmer

(e.g. 19-ST-AM-2011-SE-01-01).

The data were stored and handled in accordance with the Data Protection Directive 95/46/EC [3].

2.3.2 Survey

As written in article 4.1(d) of the Commission Decision concerning the placing on the market of Amflora [8] **all** growers of Amflora should be included into GS on the basis of the questionnaires and the IP system. That means that for the survey no sample will be drawn but a total survey (census) will be performed. In 2011, the total number of locations where Amflora was cultivated in Sweden and Germany was five. The farm questionnaires were completed by the farmers throughout the growing season.

2.4 Definition of baselines, effects and statistical test procedure

Normally - if there is no effect of Amflora cultivation or other influencing factors, and the question in the farm questionnaire being well formulated and unambiguous - one would expect a predominant part of the farmers assessing the situation to be $As\ usual$ for a certain monitoring character and only few answers $Minus$ or $Plus$ which are expected to be balanced in both $Minus$ and $Plus$ direction. Therefore the 'no effect' or 'baseline' situation may be characterized by assigning low probabilities - e.g. 5% - to the answers $Minus$ and $Plus$ and high probability - 90% - to the answer $As\ usual$ (Figure 2.1).

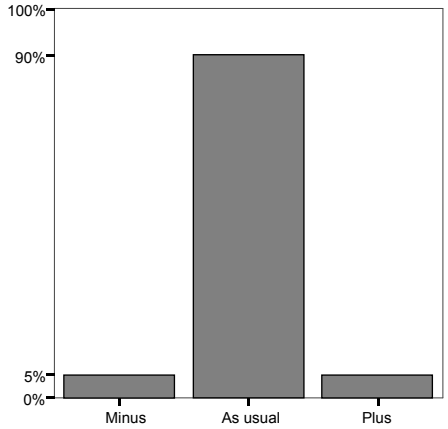


Figure 2.1: Balanced (expected) baseline distribution of the farmers´ answers (no effect)

An effect of the cultivation of Amflora or any other influencing factor would arise in a greater percentage of $Plus$ or $Minus$ answers, indicating an increase of the corresponding probability. An increase of the probability for $Plus$ or $Minus$ answers for 5% or more above the baseline level of 5% is considered as relevant. Consequently, a threshold of 10% for the probabilities of $Plus$ or $Minus$ answers is determined for identifying an effect (Figure 2.2). Graphically, an effect would be expressed by an unbalanced distribution (Figure 2.3 a and b).

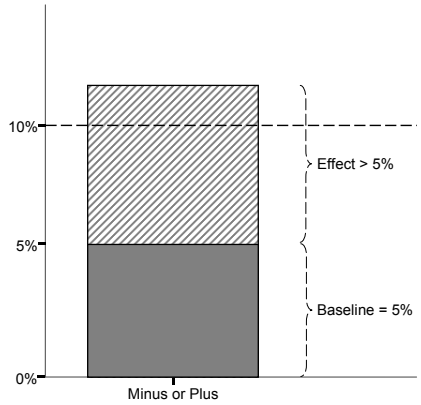


Figure 2.2: Definition of baseline distribution

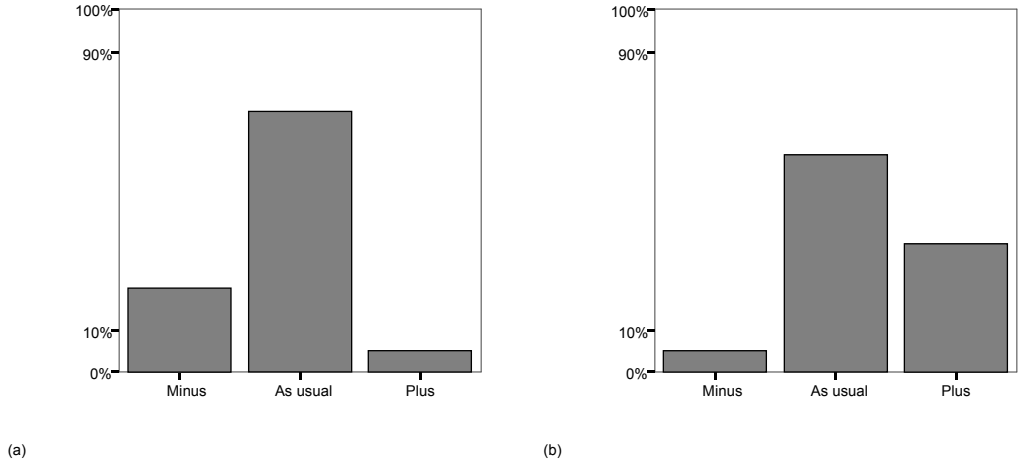


Figure 2.3: Examples for distributions of farmers' answers indicating an effect (a) $> 10\%$ in category $Minus \rightarrow$ effect, (b) $> 10\%$ in category $Plus \rightarrow$ effect

In case of Amflora monitoring where all farmers are included (census) the statistical procedures concentrate on descriptive statistics. This is contrary to the sampling approach, where test procedures to infer from the sample to the whole population are applied.

To decide whether the observed frequencies of $Plus$ or $Minus$ answers indicate an effect (i.e. an increase of the corresponding probability to 10% or more), the 99% upper confidence bound for the probability is calculated with the observed frequencies (Figure 2.4)[9]. Observed frequencies are expected to be higher than this bound only with error probability 1% or less. That means that in case this bound is lower than the threshold of 10% no indication for an effect is given. The assumption that the true probability equals or is less than the confidence bound will be correct with error probability 99%.

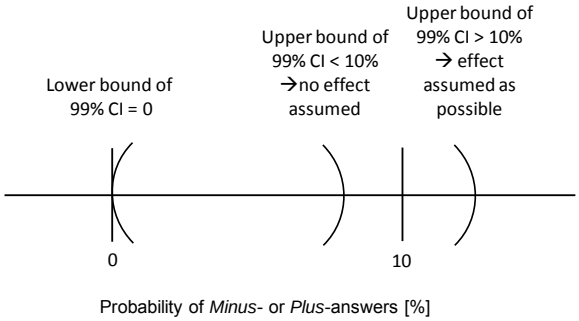


Figure 2.4: Confidence interval for the probability of $Plus$- or $Minus$-anwers

In case of sample sizes smaller than 45 the confidence bound exceeds the threshold of 10%, even if no answer was $Plus$ or $Minus$. In 2011, with five questionnaires, the 99% upper confidence bound for such probability of a $Plus$ (or $Minus$, resp.) answer will be 60%. Obviously it is not justified to assume in this case an indication for an effect and one can only decide with a higher error probability level (e.g. 10%).

The analysis of each monitoring character is performed according to the following scheme:

1. The frequencies of the farmers‘ answers for the three categories and the corresponding confidence intervals (CI) are calculated. The calculation of absolute and relative frequencies is done both on the basis of all and on the basis of valid answers. When farmers gave no statement, these answers are accounted as missing values and therefore not considered valid. As a consequence, the "valid percentages" state the proportions of the several categories of an answer that are really known, whereas the "percentages" only specify the proportions of the categories within the whole answer spectrum, including no answers.
2. The frequencies of $Plus$ and/or $Minus$ answers and their corresponding 99% upper confidence bound are compared with the threshold of 10%. If the confidence bound does not exceed 10%, no effect is assumed, otherwise an effect is assumed as possible.
3. Where an effect is indicated, the effect must be interpreted (adverse/ beneficial).
4. Where an adverse effect is identified, the cause of the effect has to be ascertained (Amflora cultivation, other influencing factors).
5. Identification of adverse effects potentially caused by Amflora cultivation requires further examinations.

2.5 Data management and quality control

The data from farm questionnaires were stored in a database. For each question a variable was defined by a variable name and a variable label (short description of the question). The variables were specified according to their type (qualitative or quantitative), format etc. Missing values were defined (0: no statement, -1: not readable). For not readable entries in the questionnaires, queries were formulated and the field representatives or farmers were asked for explanation. These entries in the database were corrected. For quantitative variables (e.g. total potato area in ha) the real values from the questionnaire were taken for the file, for qualitative variables the possible parameter values (e.g. $Plus/As\ usual/Minus$) were defined and coded (and only the code values were taken).

The database for the farm questionnaire contains ca 280 variables for five cases for the 2011 field season.

A quality control check of all cases for the 2011 field season looked at each variable for completeness (unacceptable missing values like -1: unreadable) and correctness (quantitative values within a plausible min-max range, qualitative values only with acceptable parameter values). Plausibility control checked the variable values for their contents, both to find incorrect answers and to prove the logical connections between different questions. It also looked for the consistency between $Plus/Minus$ answers and specifications, i.e. whether all these answers were provided with a specification and whether the specifications really substantiated the $Plus/Minus$ answers.

Chapter 3

Results

In 2011 Amflora was cultivated at five fields in Europe. All farmers completed the questionnaires throughout the growing season of Amflora. Quality and plausibility control confirmed that all questionnaires could be considered for analysis. A detailed analysis of the parameters surveyed with the farm questionnaire in 2011 is given in the following sections.

3.1 Farm

In 2011, five questionnaires were surveyed in the two member states of the EU where cultivation of Amflora for seed multiplication took place. These comprised four questionnaires (80%) for locations in Sweden and one (20%) for Germany.

The size of farm varied between 25.0 and 250.0 ha. The farmers used between 1.79 and 15.0 ha of their farm for cultivating potatoes at all and between 1.74 and 7.03 ha of their farm for cultivating Amflora potatoes (Table 3.1). Because all farmers cultivated Amflora at a single field the size of the surveyed field does not differ from the total area of Amflora potatoes.

Table 3.1: Farm data of surveyed fields in 2011

	N	mean	minimum	maximum
Size of farm [ha]	5	145.0000	25.00	250.00
Total area of all potatoes [ha]	5	7.6578	1.79	15.00
Total area of Amflora potatoes [ha]	5	4.0138	1.74	7.03
Size of surveyed field [ha]	5	4.0138	1.74	7.03

Farmers specified to cultivate conventional potato varieties: Fontane (2), King Edward (2), Mandel (2), Albatros (1), Ariel (1), Arrow (1), Bintje (1), Desiree (1), Energy (1), Erol (1), Fasan (1), Marianne (1), Maritiema (1), Saturna (1) and Sava (1). At two farms no conventional potato variety was planted. No other starch potatoes were cultivated at all farms.

During this survey the Amflora potato cultivation was compared with general experience in potato cultivation at all farms.

3.2 Location

3.2.1 Soil

The predominant soil type was specified for all fields (Table 3.2).

Table 3.2: Predominant soil type of surveyed fields in 2011

		Frequency	Percent	Valid percent
Valid	Heavy loam	1	20.0	20.0
	Slightly loamy sand	4	80.0	80.0
	Total	26	100.0	100.0

The soil quality rating was specified for the German field to be between 70 and 75, for three of the Swedish fields between 2 and 4 (results from different soil quality rating systems in the two countries). Not for all fields information on humus content and soil test data as pH-, P-, K-, Mg-$N_{min} - Date$ and $NO_3 - N$ -values were given (Table 3.3).

Table 3.3: Soil data of surveyed areas in 2011

	N	mean	minimum	maximum
Humus content [%]	4	4.775	2.50	7.80
pH-Value	5	6.120	5.60	6.60
P [mg]	5	7.936	6.00	11.70
K [mg]	5	12.276	12.00	13.38
Mg [mg]	2	12.450	8.50	16.58
$N_{min} - Date$	1	17.02.2011	17.02.2011	17.02.2011
$NO_3 - N$ [kg/ha]	1	24.000	24.00	24.00

The year of the soil test was specified for all fields. For three fields the soil test was made in 2011, for one field in 2000 and for one field in 1998.

At all fields a test for nematodes was performed. The results of all test were negative.

The soil fertility was characterized qualitatively for all fields. It was described to be $average - normal$ for 100% (5/5) of the fields (Table 3.4).

Table 3.4: Soil fertility of surveyed areas in 2011

		Frequency	Percent	Valid percent
Valid	below average - poor	0	0.0	0.0
	average - normal	5	100.0	100.0
	above average - good	0	0.0	0.0
	Total	5	100.0	100.0

3.2.2 Weather

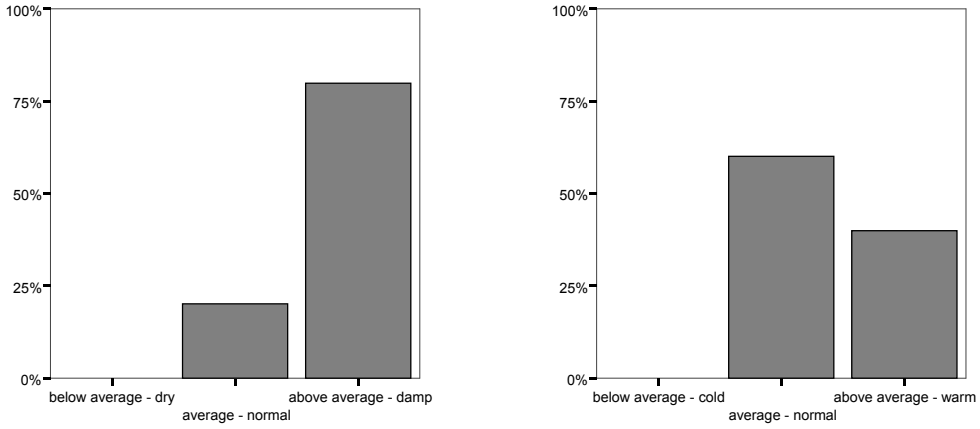
The farmers were asked to give information about the annual rainfall and temperature and to characterize the rainfall and the temperature during the growing season.

For 100.0% (5/5) of the fields statements about the average annual rainfall and the average annual temperature between the years 1961 and 1990 were given. It varied between 550 mm and 580 mm per year, in mean 563.2 mm. The averaged annual temperature varied between 1.1°C and 8.7°C, in mean 4.64°C.

The rainfall and the temperature during the growing season were characterized for all farms (Table 3.5, Figure 3.1).

Table 3.5: Characterization of rainfall and temperature of surveyed areas in 2011

		Frequency	Percent	Valid percent
Rainfall				
Valid	below average - dry	0	0.0	0.0
	average - normal	1	20.0	20.0
	above average - damp	4	80.0	80.0
	Total	5	100.0	100.0
Temperature				
Valid	below average - cold	0	0.0	0.0
	average - normal	3	60.0	60.0
	above average - warm	2	40.0	40.0
	Total	5	100.0	100.0



(a) (b)

Figure 3.1: Characterization of (a) rainfall and (b) temperature during the 2011 growing season

3.3 Cultivation measures

3.3.1 Cultivation, beginning after harvest of preceding crop

All of the interviewed farmers specified their preceding crops of the two previous years (Table 3.6).

Table 3.6: Preceding crops in 2011

Pre-crop 2 years ago	Pre-crop last year	Frequency	Percent	Valid percent
Wheat	Sugar beet	1	20.0	20.0
Wheat	Barley	1	20.0	40.0
Grass	Grass	1	20.0	60.0
Barley	Barley	1	20.0	80.0
Rye	Oat	1	20.0	100.0
Total		5	100.0	100.0

The soil was tilled at all fields. 60.0% of the fields (3/5) were tilled in $Fall\ or\ Winter$, 20.0% (1/5) in $Spring$ and 20.0% (1/5) in $Fall\ or\ Winter$ and $Spring$ (Table 3.7).

Table 3.7: Time of tillage in 2011

		Frequency	Percent	Valid percent
Valid	Fall or Winter	3	60.0	60.0
	Spring	1	20.0	20.0
	Fall or Winter and Spring	1	20.0	20.0
	Total	5	100.0	100.0

80.0% (4/5) of the fields were tilled with a $turning$ method. Only one field (20.0%) was tilled with a $non-turning$ method (Table 3.8).

Table 3.8: Tillage method in 2011

		Frequency	Percent	Valid percent
Valid	Turning	4	80.0	80.0
	Non-turning	1	20.0	20.0
	Separating	0	0.0	0.0
	Total	5	100.0	100.0

At one field (20.0%) the inter crop $Englisch\ ray\ grass$ was planted.

At 80.0% of the fields (4/5) additional prior planting soil cultibvation was performed between April 6 and June 14. The used methods were:

- rotary harrow and rotary hiller (1 field),
- mill ridging (2 fields) and
- milling (1 field).

3.3.2 Data relating to seed potatoes

The category of the used seed potatoes was specified for all fields. The farmers stated to have used seeds of the categories: SE2 (2), S1-S2 (1), SS-S1-S2 (1) and breeders own prestage (1).

For all fields the question on sprouting was answered. It was characterized to be between 35% and 100%, in mean 73%.

Also the tuber size (calibration) was described for all fields (Table 3.9).

Table 3.9: calibration of seed potatoes in 2011

		Frequency	Percent	Valid percent
Valid	smaller than 35 mm	1	20.0	20.0
	35 - 55 mm	3	60.0	60.0
	bigger than 55 mm	0	0.0	0.0
	35 - 55 mm and bigger	1	20.0	20.0
	Total	5	100.0	100.0

The quantity of seed potatoes was specified for 80.0% (4/5) of the fields, it was between 2.0 and 2.96 t/ha in mean 2.6388 t/ha. For one of the fields the quantity of seed potatoes was not described in t/ha but it was stated that 78000 tubers/ha were planted.

For all fields the question on treatment/coating was answered. 80.0% (4/5) of the farmers treated the seed potatoes before planting. The chemicals used for seed treatment were Maxim, Monceren, Cuprozin and FZB 24 (Table 3.10). The seed potatoes for one field were not treated. This field was situated in Sweden (planted with mini tubers).

Table 3.10: Treatment of seed potatoes in 2011

		Frequency	Percent	Valid percent
Valid	Monceren (60 ml/dt) and Cuprozin (0.4 l/ha) (50%),			
	Monceren (60 ml/dt) and FZB 24 (0.5 kg/ha) (50%)	1	20.0	25.0
	Monceren (1.8 l/ha)	1	20.0	25.0
	Maxim (1.1 l/ha)	2	40.0	50.0
	Total	4	80.0	100.0
Missing	no treatment	1	20.0	
Total		5	100.0	

3.3.3 Planting / Cultivation / Development

The Amflora potatoes were planted between May 7 and June 15. Ridges were formed by 80% of the farmers (4/5) and by 50% of them (2/4) twice between May 7 and July 5. The emergence started between May 30 and July 1 and ended between May 31 and July 15 (Table 3.11). The soil temperature during planting was between 9°C and 16°C, in mean 12°C. Amflora potatoes were planted in rows with a distance that varied between 75 and 85 cm in mean 79 cm and with a plant distance that varied between 18 and 24,25 cm in mean 22.59 cm.

Table 3.11: Data of planting, forming ridges and emergence in 2011

	N	mean	minimum	maximum
Planting date	5	21.05.2011	07.05.2011	15.06.2011
Forming ridges Date 1	4	01.06.2011	07.05.2011	29.06.2011
Forming ridges Date 2	2	02.07.2011	29.06.2011	05.07.2011
Emergence from	5	13.06.2011	30.05.2011	01.07.2011
Emergence till	5	25.06.2011	31.05.2011	15.07.2011

The farmers used the standard planting method (with plowed furrows) and the mulch planting method (Table 3.12).

Table 3.12: Planting method in 2011

		Frequency	Percent	Valid percent
Valid	standard planting	3	60.0	60.0
	mulch planting	2	40.0	40.0
	Total	5	100.0	100.0

The farmers stated dates for up to four checks for offtypes from June 16 to July 29.

In 2011 no field was irrigated.

The farmers were asked to characterize the sprouting, the time to emergence, the plant growth and the agronomic characteristics of the Amflora plants in comparison to the reference specified in section 3.1. All four monitoring characters were described to be $as\ usual$ for 100.0% (5/5) of the fields (Table 3.13).

Table 3.13: Characterization of sprouting, time to emergence, plant growth and agronomic characteristics in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Sprouting					
Valid	poorer	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	better	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Time to emergence					
Valid	accelerated	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	delayed	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Plant growth					
Valid	accelerated	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	delayed	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Agronomic characteristics					
Valid	as usual	5	100.0	100.0	
	different	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

3.3.4 Fertilization

Organic fertilizers were not used, but at all fields up to four different mineral fertilizers were applied between March 3 and June 22.

The most common mineral fertilizer, NPK 8-5-19, was used at four fields (80.0%) in a quantity between 600 and 1000 kg/ha (content of this fertiliser: N 50 - 80 kg, P 20 - 50 kg, K 114 - 190 kg, Mg 22,5 kg).

Other specified mineral fertilizers with described applied amount and content are:

- Kalksalpeter (at 2 fields: 150 - 200 kg/ha, content: N 23 - 30 kg,
- AHL 28% (at 1 field: 286 kg/ha, content: N 80 kg),

- TSP 46% (at 1 field: 220 kg/ha, content: P 101 kg),
- P-20 (at 1 field: 200 kg/ha, content: P 20 kg),
- P-9 (at 1 field: content: P 9 kg),
- Kalimagnesia (at 1 field: 250 kg/ha, content: K 50 kg),
- K-40 (at 1 field: 100 kg/ha, content: K 40 kg,
- Potash 40% (at 1 field: 510 kg/ha, K 204 kg, Mg 31 kg) and
- Kiserit (at 1 field: 140 kg/ha, content: Mg 35 kg).

3.3.5 Chemical weed control

The weed pressure compared to reference specified in section 3.1 was characterized for all fields. At one of them (20.0%) there were fewer weeds, at three fields (60.0%) the weed pressure was $as\ usual$ and at one field (20.0%) more weeds occured (Table 3.14, Figure 3.2).

Table 3.14: Weed pressure on Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	fewer weeds	1	20.0	20.0	77.8
	as usual	3	60.0	60.0	
	more weeds	1	20.0	20.0	77.8
	Total	5	100.0	100.0	

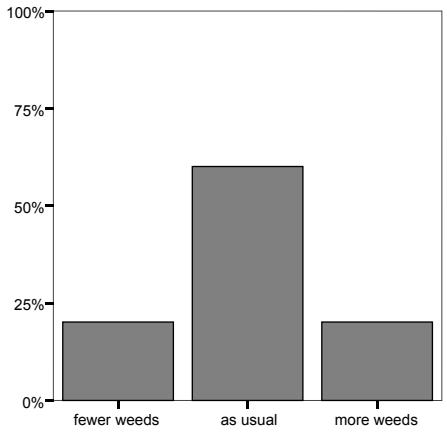


Figure 3.2: Weed pressure on Amflora in 2011 compared to reference specified in section 3.1

The weeds that occurred in Amflora fields with their frequencies of nomination are listed in Table 3.15. The applied herbicides with frequency and used quantity are listed in Table 3.16. The application dates of herbicides were between May 25 and August 4.

Table 3.15: Weeds in 2011

Weed	Frequency
Chenopodium album	2
Fallopia convolvulus	2
Matricaria perforata	2
Barley volunteers	1
Brassica nappus	1
Centaurea cyanus	1
Digitaria	1
Galium aparine	1
Matricaria chamomilla	1
Solanum nigrum	1

Table 3.16: Used herbicides in 2011

Herbicide	Frequency	Quantity[kg/ha]
Sencor	5	0.25 - 0.5
Titus	4	0.03 - 0.04
Boxer	1	4
Fenix	1	1.3

The success of the weed control on Amflora potatoes in relation to reference specified in section 3.1 was characterized to be $as\ usual$ at 100.0% (5/5) of the fields (Table 3.17).

Table 3.17: Success of weed control in Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	poorer	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	better	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

3.3.6 Occurrence of pests / treatment

The general occurrence of pests in Amflora and the susceptibility to pests of Amflora in in relation to reference specified in section 3.1 were described to described to be $as\ usual$ for all (100.0%) fields (Table 3.18.

Table 3.18: Occurrence of pests in Amflora and susceptibility to pests of Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Occurrence of pests					
Valid	fewer pests	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more pests	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Susceptibility to pests					
Valid	less susceptible	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more susceptible	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

The only pest that occurred on the Amflora potato fields were aphids. They were controlled at all fields. The used insecticides are listed in Table 3.19 (including the frequency and quantity of using). The pest control was performed between May 29 and August 24.

Table 3.19: Used insecticides in 2011

Insecticide	Frequency	Quantity[kg/ha]
Oil (Repellent)	25	4 - 7
Sumicidin alpha	17	0.2 - 0.3
Mavrik	6	0.2 - 0.25
Pirimor	5	0.3 - 0.45
Actara	4	0.1
Mospilan SG	4	0.15 - 0.25
Beta-Baytroid	3	0.4
Biscaya	3	0.3
Dantop	2	0.15
Karate Zeon	2	0.08
Plenum 50 WG	2	0.3
Tepikki	2	0.16

The success of pest control in Amflora potatoes in relation to reference specified in section 3.1 was characterized to be $as\ usual$ at all fields (Table 3.20).

Table 3.20: Success of pest control in Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	poorer	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	better	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

3.3.7 Occurrence of disease / treatment

The farmers were asked to evaluate the occurrence of diseases on Amflora potato fields and the susceptibility of Amflora potatoes to diseases in relation to the reference specified in section 3.1 in general. Both monitoring characters were described to be $as\ usual$ at 100.0% of the fileds (Table 3.21.

Table 3.21: Occurrence of diseases in Amflora and susceptibility to diseases of Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Occurrence of diseases					
Valid	fewer diseases	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more diseases	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Susceptibility to diseases					
Valid	less susceptible	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more susceptible	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

Late blight

The farmers evaluated the pressure caused by late blight (*Phytophthora infestans*) in Amflora potatoes in relation to the reference specified in section 3.1 to be $as\ usual$ at 100.0% (5/5) of the fields (Table 3.22). The applied fungicides with frequency and quantity of using are listed in Table 3.23. Fungicides were applied between June 20 and August 24.

Table 3.22: Occurrence of late blight in Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	less late blight	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more late blight	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

Table 3.23: Used fungicides in 2011

Fungicide	Frequency	Quantity[kg/ha]
Ranman	18	0.2
Tattoo	6	2 - 4
Shirlan	3	0.4
Vondac DG	3	1.2
Epoc	2	0.4 - 0.5
Infinito	2	1.5 - 1.6
Orvego Duo	2	2.5
Revus	2	0.6
Fantic	1	2.5
Signum	1	0.25

The success of control measures for late blight in Amflora potatoes in relation to comparator variety or similar varieties was $as\ usual$ at all fields (Table3.24).

Table 3.24: Success of control measures for late blight in Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	poorer	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	better	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

Other diseases

Other diseases than late blight occurred at 100.0% (5/5) of the Amflora potato fields. The diseases that occurred and the frequency of occurrence and the description of control measures are listed in Table 3.25. All measures were performed between May 5 and July 29.

Table 3.25: Other diseases in Amflora potatoes in 2011

Disease	treatment	frequency
Blackleg, stem canker	Seed treatment	3
	Selection	3
Potato virus Y (PVY)	Selection	5
Rhizoctonia solani (black scurf)	Seed treatment	3
	Selection	1
Potatoe leaf roll virus (PLRV)	Selection	1

At all fields the success of control measures for other diseases in Amflora potatoes in relation to reference specified in section 3.1 was characterized to be $as\ usual$ (Table 3.26).

Table 3.26: Success of control measures for other diseases in Amflora potatoes in 2011 in relation to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	poorer	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	better	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

3.3.8 Use of herbicides for haulm killing

The common methods that are used for haulm killing are chemical (use of herbicides) and mechanical measures. At 80.0% (4/5) of the fields $only\ chemical\ measures$ and at 20.0% (1/5) of them $both\ methods$ were used (Table 3.27).

Table 3.27: Haulm killing methods in 2011

		Frequency	Percent	Valid percent
Valid	chemical measures only	4	80.0	80.0
	mechanically only	0	0.0	0.0
	both methods	1	20.0	20.0
	Total	5	100.0	100.0

The herbicides used for haulm killing were:

Reglone, at 5 fields,
Spotlight, at 4 fields and
Shark at 1 field.

3.3.9 Harvest

The farmers harvested the Amflora potatoes between August 31 and October 2. The yield was between 8.0 (from mini tubers) and 31.02 t/ha, in mean 22.3032 t/ha.

The farmers were asked to characterize the maturity, the date of harvest and the yield in comparison to the reference specified in section 3.1. The maturity was described to be $as\ usual$ at 100.0% (5/5) of the fields. The date of harvest was $as\ usual$ at 60.0% (3/5) and $delayed$ at 40.0% (2/5) of the fields. The yield was $less$ in 40.0% (2/5) and $as\ usual$ in 60.0% (3/5) of the cases (Table 3.28, Figures 3.3 and 3.4).

Table 3.28: Characterizations of maturity, date of harvest and yield in 2011 compared to the reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Maturity					
Valid	accelerated	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	delayed	0	0.0	0.0	60.2
	Total	5	100.0	100.0	
Date of harvest					
Valid	accelerated	0	0.0	0.0	60.2
	as usual	3	60.0	60.0	
	delayed	2	40.0	40.0	90.7
	Total	5	100.0	100.0	
Yield					
Valid	less yield	2	40.0	40.0	90.7
	as usual	3	60.0	60.0	
	more yield	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

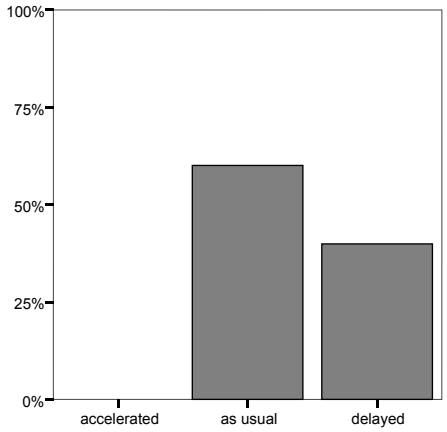


Figure 3.3: Characterizations date of harvest in 2011 compared to the reference specified in section 3.1

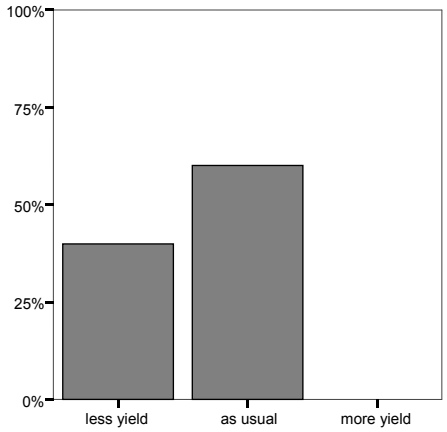


Figure 3.4: Characterizations of yield in 2011 compared to the reference specified in section 3.1

All farmers who detected differences from $as\ usual$ did explain them. The explanations are listed in Table 3.29.

Table 3.29: Specification of differences in maturity, date of harvest and yield in 2011 compared to the reference specified in section 3.1

Answer	**Count of Nomination**	**Explanation**
Date of harvest		
delayed	1	Much rain before harvest
delayed	1	Harvest was delayed because of a lot of rain this season
Yield		
less	1	Minitubers and wet spots reduced the harvest amount
less	1	Much rain before and under harvest, wet spots in the field had to be left

3.4 Presence of wild animals

All farmers answered the question on their general impression regarding presence of wild animals in their Amflora potato fields in relation to the reference specified in section 3.1. At all fields (100.0%) it was $as\ usual$ (Table 3.30).

Table 3.30: Presence of wild in Amflora in 2011 compared to reference specified in section 3.1

		Frequency	Percent	Valid percent	Upper bound of 99% CI
Valid	less wild	0	0.0	0.0	60.2
	as usual	5	100.0	100.0	
	more wild	0	0.0	0.0	60.2
	Total	5	100.0	100.0	

3.5 Additional comments

No farmer wrote an additional comment on his observations during the planting season.

Chapter 4

Summary of results - Discussion

The results of the descriptive analysis of monitoring characters surveyed with the farm questionnaire during the 2011 growing season are summarized in Table 4.1.

Table 4.1: Overview on the results of the descriptive analysis of the monitoring characters in 2011

Monitoring characters	$Valid$	$Minus$	$As\ usual$	$Plus$
Sprouting	5	0.0%	100.0%	0.0%
Time to emergence	5	0.0%	100.0%	0.0%
Plant growth	5	0.0%	100.0%	0.0%
Agronomic characteristics	5		100.0%	0.0%
Weed pressure	5	20.0%	60.0%	20.0%
Success of weed control	5	0.0%	100.0%	0.0%
Occurrence of pests	5	0.0%	100.0%	0.0%
Pest susceptibility	5	0.0%	100.0%	0.0%
Success of pest control	5	0.0%	100.0%	0.0%
Occurrence of disease	5	0.0%	100.0%	0.0 %
Disease susceptibility	5	0.0%	100.0%	0.0%
Late blight pressure	5	0.0%	100.0%	0.0%
Success of late blight control	5	0.0%	100.0%	0.0%
Success of control of disease	5	0.0%	100.0%	0.0%
Maturity	5	0.0%	100.0%	0.0%
Date of harvest	5	0.0%	60.0%	40.0%
Yield	5	40.0%	60.0%	0.0%
Presence of wild animals	5	0.0%	100.0 %	0.0%

For all monitoring character values $Plus$ and $Minus$ additionally the corresponding 99% upper confidence bounds were calculated (see tables in the text). Due to small number of questionnaires, no upper confidence bound was lower than the threshold of 10%.

The summary shows - considering the small sample size of five - mainly balanced distributions with a predominant part of the farmers assessing the situation to be $as\ usual$ for most monitoring characters. Evident deviations from this baseline pattern are observable for the characters date of harvest and yield. This clearly can be explained by weather conditions, as it was specified in the farmers' explanations or in the influencing factors (rain fall, temperature).

Chapter 5

Conclusions

A total of five farm questionnaires addressing the different monitoring characters were collected from all growers participating in the IP system for cultivation of Amflora potato, and analyzed. An evaluation of the monitoring characters that were rated $as\ usual$ or were deviating from what is in general observed for potato cultivation by the growers allowed the following conclusions. For most characters Amflora performed as any conventional potato variety (e.g. sprouting, plant growth, time to emergence, agronomic characteristics, success of weed, pest or disease control, presence of wildlife). The deviations (later harvest, lower yield) were clearly a consequence of adverse weather conditions and other influencing factors, and none of them were considered as adverse effects.

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