Low Yield II

Cumulative impact of hazard-based legislation on crop protection products in Europe

March 2020

European Crop Protection

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Contents

Foreword

Agriculture is important in Europe. The Common Agricultural Policy (CAP), which was set up to improve agricultural productivity and to ensure a secure supply of food, currently constitutes 38% of the entire EU budget. Largely as a result of the CAP, this goal has been achieved and rural communities have been protected. This has been a remarkable achievement in the post-World War II era.

Although the CAP has gradually shifted away from production subsidies to producer support, some stakeholders argue that it has led to an agricultural system which over-emphasises the cost-efficiency of food production for European citizens. This system relies on the availability of chemical fertilizers and crop protection products to increase plant growth whilst managing and controlling diseases and pests. Today, there are increasing societal concerns over the environmental, biodiversity and health effects of these substances. Alternative production systems are promoted as viable substitutes. Organic farming for example, has grown rapidly and the EU is now the second largest retail market for organic products after the USA.

Despite this growth, organic farmland currently makes up a modest 7.2% of agricultural land in the EU according to the institute of Organic Agriculture. Conventional agriculture remains the dominant production system and pesticides, therefore, still play a crucial role. However, as the EU has shifted from a risk-based legislation towards a hazard-based one over the last decade, a significant number of pesticides have been removed from the market while more are increasingly at risk of being phased out due to the very stringent regulatory requirements in the EU. At the same time, the introduction of viable substitutes is becoming increasingly difficult. This depletes the 'toolbox' that farmers have at their disposal to protect their crops from pests and diseases.

The socio-economic impact of this depletion has received much less attention than the environmental, biodiversity and health impacts of pesticides. Steward Redqueen was commissioned by ECPA to shed more light on impacts such as crop yields, costs of production and farmer incomes. This is the second volume of a report originally published in 2016 and looks at an additional seven countries. The EU aggregate results in this report also include the nine countries of the first volume for a total of 16 countries. Because agriculture is so intricately linked with the rest of society, we do not claim that these reports contain a complete assessment of all economic aspects of phasing out pesticides. Rather they focus on short-run farm-level effects by looking at a substantial number of staple and specialty crops using data provided by local crop experts.

The findings of this report should not be considered in isolation but rather as complementary to findings in the areas of environment, biodiversity and health. Having said that, based on extensive data and expert opinions, this report argues that phasing out 75 pesticides will cause lower yields while increasing costs of production. This will have a profound negative effect on farmer incomes. These negative impacts may well be mitigated to some extent as the best-available alternative options could be better than currently assumed by the experts. However, it could also be the case that the actual impacts, due to additional factors such as climate change and invasive alien species, have been underestimated. This could then lead to an increase in pest pressure, in addition to accelerating resistance effects as a result of a decreased toolbox.

As was the case with the first volume, this report has also been peer reviewed by two experts from Wageningen University. These reviews as well as our response to them are available on the ECPA website. To transform the way in which European farmers ensure a steady supply of safe and nutritious food for 500 million EU consumers, it is important for policymakers and civil society to consider all the trade-offs. We hope that this report contributes to the current policy discussions concerning the need to move towards an increasingly sustainable food production model.

Steward Redqueen

About the authors

COMPANY PROFILE

Steward Redqueen is a strategy consultancy firm that aims to make business work for society. The company executes projects around the world from its offices in Amsterdam, Barcelona, Singapore and Stockholm. Since 2000, Steward Redqueen's team has focused on integrating sustainability, quantifying impact and facilitating change. Clients include commercial and development financial institutions, impact investors, multinational enterprises, network organizations and government agencies. For more information visit: www.stewardredqueen.com

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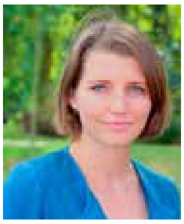

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TRACK RECORD SOCIO-ECONOMIC IMPACT ASSESSMENTS

Since 2006 Steward Redqueen has completed more than 150 socio-economic impact studies for many multinational companies and development finance institutions in Africa, Asia, Australia, Latin America, North America and Europe.

REVIEWERS

We are very grateful to Professors Linda M. Field and John Lucas of Rothamsted Research as well as Professor Justus Wesseler and Mr. Chris de Visser of Wageningen University and Research who kindly provided us with their expert opinions in volumes one and two respectively. Their comments and suggestions have improved the methodology, analysis and this report.


01

Introduction

The EU is one of the world's largest agricultural producers, and farmers in the EU can count themselves among the most productive in the world. Over the past 20 years, EU food production per capita has consistently increased, now far outstripping dietary energy requirements. The productivity gains are the result of the EU's good agricultural soils, the exceptional level of know-how, sufficient water availability and an attractive climate.

Nonetheless, European farmers today face a number of socio-economic and environmental challenges. Farmer income is almost 40% lower than non-agricultural income. Throughout the EU, the labour force in the agricultural sector is ageing and shrinking; only 5.6% of all European farms are run by farmers younger than 35, and more than 31% of farmers are over 65 years. Furthermore, the European Commission (EC) predicts that European farmers will increasingly contend with uncertainties such as more volatile producer prices and extreme weather events.

The EC estimates that, in 2017, at least 20% of farmers experienced an income loss of more than 30%, with income variability particularly high for cereal and oilseed farmers.[1]

Agricultural viability in the EU

To meet the food quantity, quality and price demands of the European consumer in today's operating environment, many European farmers rely on the Common Agricultural Policy (CAP). The CAP, launched in 1962, aims to ensure that: the EU has a stable source of local food production; rural communities and lifestyles remain intact; natural resources and the environment are protected; and farming remains an economically viable profession. This is achieved through income support, the promotion of rural development and the application of market measures. Today, the CAP represents 38% of the EU's total expenditure (€408 billion).[2]

1 *The income loss was relative to the average income over the three preceding years.*

2 *https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap_en*

Support[3] for agriculture through the CAP has a significant impact on the total income of farms in the EU. The relative importance of EU support for income formation can be examined through the ratio between the subsidy payments and the farm net value added.[4] The average share of subsidies in farm net value added in the EU is 38%, which means agricultural support represents more than a third of the farm income (Exhibit 1).

European farmer productivity

The level of CAP support is indicative of the average farm productivity of EU countries. Farm productivity can be simply defined as the amount of resources, including land, capital and intermediary inputs, required to achieve agricultural output. Important productivity drivers include the productivity of labour and capital, but also external factors such as pest pressure, climate and land arability. To illustrate, although farm labour productivity in Sweden at €30,000 is high when compared to the EU average of €17,800, the average Swedish farmer receives strong CAP support because of the more difficult climate (73% of farm net value added).[5] Similarly, pest pressure can greatly affect annual farm productivity by reducing yields and quality or spoiling and destroying harvests. The irregularity of pest pressure, often in combination with annual weather pattern changes, can lead to large variations in crop output.

To maximise crop yields and quality and minimise yield volatility, European farmers often make use of the farmer toolbox. Ideally, farmers, as per Integrated Pest Management, employ a variety of strategies such as crop rotation, seed and variety

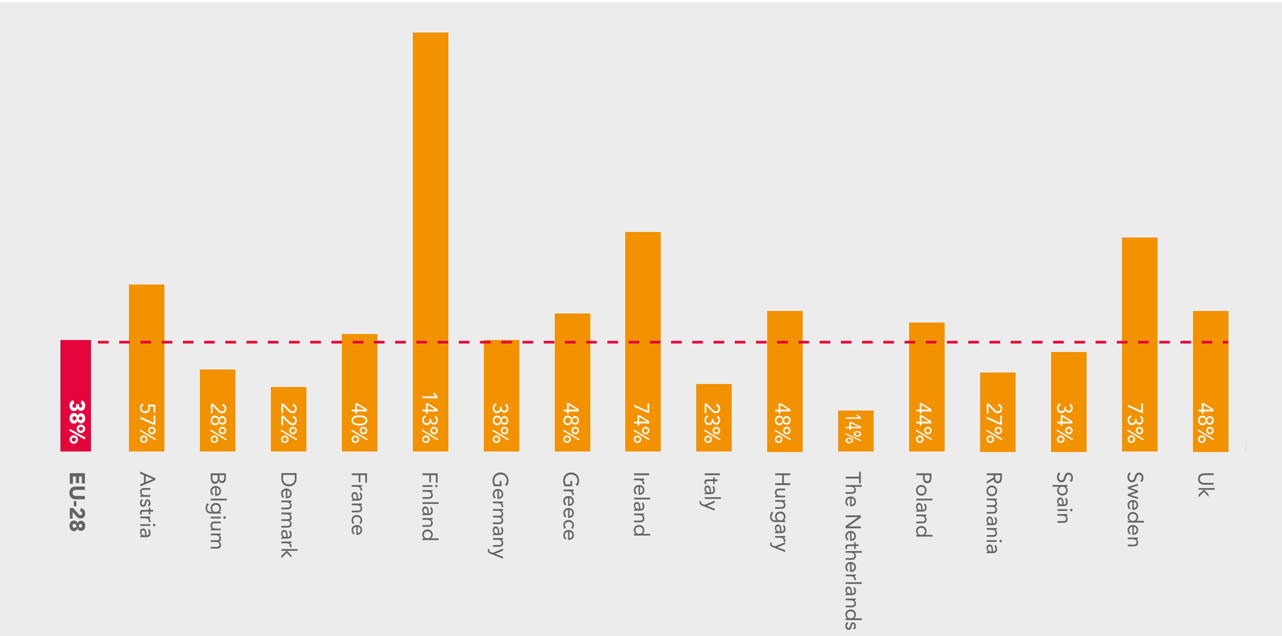


***Exhibit 1**: Share of subsidies³ in farm net value added 2016 for all countries in scope (%)*

3 *Total subsidies (including direct payments and rural development support, but not investment support) as a share of agricultural value added in the 2010–2012 period.*

4 *Farm net value added is the compensation to the farms for their work and capital.*

5 *European Commission (2017) Agriculture and farm income.*

selection, cultivation practice, pesticide usage, planting dates and planting densities. These strategies allow farmers to take the appropriate measures to control pests and diseases in their crops and deal with unexpected weather patterns. The choice of strategies employed by farmers is determined by culture, climate and regulations, and given the diversity of these variables across Europe, no farmer toolbox is the same. Nonetheless, for most farmers in the EU, crop protection products are an important component of their toolbox to ensure maximum crop production, with pesticides now seen to be "locked in" to many cropping systems. [6]

A restricted toolbox

Diversity in available substances is crucial for facing immediate pest pressure and preventing long-term resistance effects. The European farmer, however, is increasingly facing a restricted toolbox due to the reduced availability of pesticides.

First, the role of pesticides in the European farmer's toolbox has become increasingly contentious. As a recent European Commission report highlights, there exists a great "plurality of strongly held views in different sections of society concerning perceived levels of risk and what constitutes acceptable risk in health, environment and food safety related areas."[7] In its pivot towards greening its agricultural sector, the EU has shifted from risk-based to more hazard-based legislation. While these terms are often used interchangeably, in research literature, they refer to different degrees of precaution. Hazard becomes a risk depending on exposure: watching a shark from the beach is a hazard but becomes a risk when swimming. This shift towards risk evaluation of crop protection substances from a hazard-based perspective has implications for the farmer toolbox, i.e. the amount of solutions available for pest control. This hazard-based stance is believed to have contributed to the list of permitted substances dropping from 1000 in the 1990s to fewer than 400 active substances available for European farmers today.[8]

Second, withdrawn substances are not likely to be easily replaced given the low levels of active ingredient development. The pipeline of products waiting for approval for the European market is diminishing due to rising research and development (R&D) time and costs (i.e. 70 substances in the pipeline in 2000, down to 28 in 2012).[9] Latest estimates show that the development of a new active ingredient up to market introduction takes about 11 years and costs over $280 million.[10]

Socio-economic effects of a restricted toolbox

European farmers rely on their toolboxes to protect their crops and ensure stable yields and incomes, and a restricted farmer's toolbox can put the economic viability of European agriculture under pressure. To shed light on the socio-economic effects of a restricted farmer toolbox in the EU, the ECPA, along with their respective national organisations, commissioned Steward Redqueen to examine the current value of 75 at-risk substances to European agriculture.[11]

Steward Redqueen's work builds on similar studies undertaken by Wageningen University, the Andersons Centre, the Humboldt Forum and Teagasc at the national or product levels. The work complements environmental and health-impact assessments of crop protection products by helping to provide a complete picture of the societal effects of CPP usage.

This study covers the expected effects on crop production levels, farmer incomes and profitability, jobs, carbon footprint and land use. In this report, we address the socio-economic effects on farmers

6 *ENDURE Foresight study.*

7 *EU authorisation processes of Plant Protection Products, Source: European Commission, SAM Group of Chief Scientific Advisors.*

8 *Development of approved active substances, Source: European Commission, Healthy Harvest, NFU.*

9 *Phillips McDougall, R&D trends for chemical crop protection products, Sept 2013.*

10 *Phillips McDougall, Agrochemical research and development: the costs of new product discovery, development and registration, 2016.*

11 *While no definitive decision on which active substances are facing withdrawal has been made, earlier research identified some 75 out of the total 400 substances currently available are to be phased out.*

in Belgium, Denmark, Finland, Greece, Hungary, Romania and Sweden. This report is the second in a series of two; the first ECPA Low Yield Report was published in July 2016 and covers Austria, France, Germany, Italy, Ireland, the Netherlands, Poland, Spain and the UK. The 45 crops in the 16 countries in scope cover almost half of total EU production value (Exhibit 2).

The basis of the analysis is the immediate yield and variable cost production effects that result from a restricted farmer toolbox, i.e. the farm-level changes. To establish these changes, this study relies on input from agronomic experts from European farmer organisations, agri-cooperatives, technical institutes and universities, and ECPA's national associations (Table 1). The involvement of these national experts is key to obtaining credible results. Furthermore, the study relies on the best available national statistics and EU databases for crop production and cost structure statistics. The data sources used, and the method employed by the study, as described in the next chapter, ensure that the study is entirely reproducible.

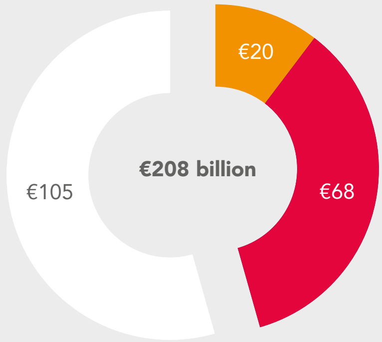


***Exhibit 2**: Total production value of staple and specialty crops in scope for all countries in scope (€m)*

***Table 1**: Expert organisations consulted in Phase Two countries*

Country	Expert Organisations
BELGIUM	INAGRO UGent, KULeuven Boerenbond, Phytofar, FIWAP, Departement Landbouw en Visserij
DENMARK	SEGES, Dansk Platevaern, DAFC
FINLAND	MTK, KASTE
GREECE	MINAGRIC, HCPA, Gaia Epicheirein, Panhellenic Federation of Associations of Agronomists, Thessaly Government, Ministry of Rural Development and Food
HUNGARY	NAK
ROMANIA	AIPROM, LAPAR, Pro Agro, APPR, ICDP Pitesti Maracieneni, FNCR, Mircea Marmureanu, MARCOSER, USAMV Bururesti
SWEDEN	Swedish Cereal Growers Association, The Rural Economy and Agricultural Societies, Federation of Swedish Farmers, Swedish Crop Protection Association, Association of Swedish Sugar Beet Growers, Swedish Potato Growers Association, Nordic Beet Research

Structure of the report
The remainder of this report covers the following topics:

- Section 2 outlines the methodology used to study the socio-economic effects;
- Section 3 presents the EU-level results, specifically the effects on crop production levels, farmer incomes and profitability, and EU self-sufficiency;
- Section 4 presents the country-level employment effects for all 16 countries in scope;
- Sections 5 through 11 present the socio-economic effects for individual countries;
- The annexes provide detailed overviews of the data sources and figures used in the analyses.

The glyphosate debate
The recent debates surrounding the future of glyphosate are a good illustration of how contentious pesticide usage in Europe has become. Glyphosate is the most frequently used herbicide in the EU. It received market approval in 2002 following an extensive assessment of its effects on the environment and human and animal health. In 2016, however, EC approval of glyphosate usage was set to expire. When the commission proposed its renewal, there was insufficient support both for and against approval. A discussion of the potential carcinogenicity of glyphosate was underway at the time, and the pesticide was at the centre of considerable public and private debate. Before making a final decision, the European Commission tasked the European Chemical Agency (ECHA) to assess the potentially hazardous properties of glyphosate. In March 2017, the ECHA concluded that there was no evidence to link glyphosate to cancer in humans, and it was stated that glyphosate should not be classified as a substance that causes genetic damage or disrupts reproduction. The European Commission subsequently reopened discussion with Member States for approval. Following a vote on 27 November 2017, glyphosate was approved for a further five years.


2

Methodology

SCOPE OF THE STUDY

Socio-economic effects

The study covers the effects on crop production levels, farmer incomes and profitability, jobs and self-sufficiency. Additionally, the study translates the self-sufficiency effects into high-level estimations of impacts on carbon footprint and land use.

Countries and crops

The study, consisting of both Phase One and Phase Two, covers 16 countries in the EU and 45 crops, of which seven are staple and 38 specialty crops. Staple crops are: wheat, barley, maize, grapes, potatoes, sugar beets and oilseed rape (OSR). Specialty crops include, for instance, tulips in the Netherlands, rye in the Nordic countries and cotton in Greece (for a full list of Phase Two countries, please see the individual country chapters). At the EU level, the effects of the removal of the 75 substances are studied only for the seven staple crops.

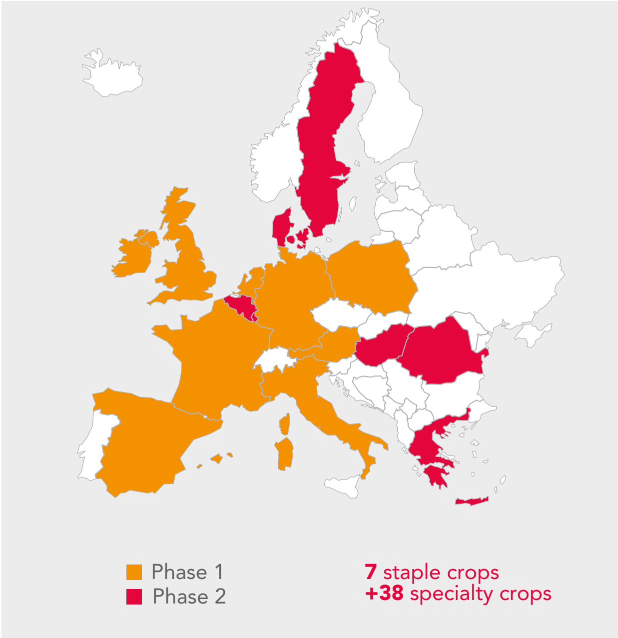


***Exhibit 3**: Countries and crops in scope (Phases One and Two)*

Regulations and active ingredients

EU Regulation 1107/09, Regulation 485/2013 and the Water Framework Directive (WFD) form the basis of identifying which substances are likely to be phased out (Exhibit 4). As it is not yet possible to produce a definitive list, this study makes use of existing academic literature to establish a working catalogue of at-risk active substances. This study makes use of a list of 87 overall and 75 non-UK-specific or low-risk active substances drafted by the Andersons Centre, which reflects the research of the UK's DEFRA and HSE-CRD[12] and the European Commission. For a detailed overview of the 75 substances, please consult the annex.

12 DEFRA is the UK's Department for Environment, Food & Rural Affairs; HSE–CRD is the UK government's Chemicals Regulation Division.

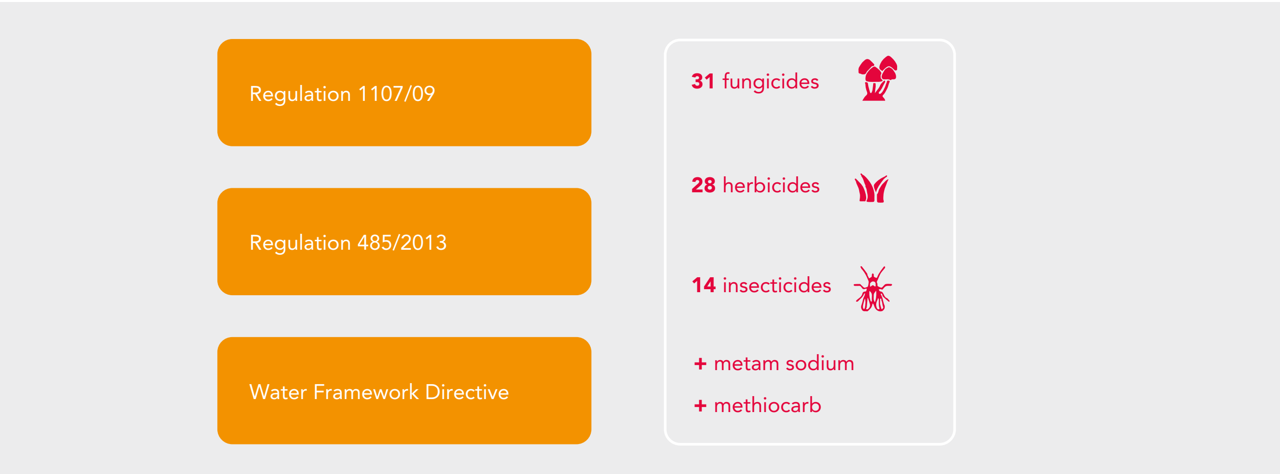


***Exhibit 4**: Relevant regulations used to determine 75 at-risk substances*

DATA COLLECTION

All the data used in the study is from publicly available data sources (EUROSTAT or national statistical offices) or was provided by technical institutes and representatives of farmer organisations. Throughout the data collection phase of the study, all inputs were verified by the expert organisations. It is important to note that for all data inputs for which a range was available, namely the yield and production cost change estimations, the most conservative figures were used in the analysis.

FARM-LEVEL DATA

To understand the effects of a restricted farmer's toolbox, expert organisations were consulted in all seven countries (Table 2). These experts provided and/or verified the data necessary to establish farm-level income with and without the 75 substances for the crops in scope (Table 2). For a detailed list of sources per country please refer to the annex. In principle, the experts relied on EUROSTAT for production area, ex-farm price and yield data but in some cases EUROSTAT data was considered as unrealistic or inferior to other national data sources, in which case the latter were used. Regarding production costs and associated changes therein, the experts relied on their own data sources and opinions. Although the Farm Accountancy Data Network (FADN) provides harmonised production cost data across countries, many experts preferred the estimations from their own organisations as a baseline against which to judge the effect of a restricted toolbox. In Sweden, however, the FADN data were used.

***Table 2**: Overview of data sources for farm-level analysis per country and crop (t = tonne and ha = hectare)*

Indicator	Unit	Source
EX-FARM PRICE	(€/t)	Expert organisation; EUROSTAT; national statistical office
YIELD	(t/ha)	Expert organisation; EUROSTAT; national statistical office
PRODUCTION COST	(€/ha)	Expert organisation; national statistical office
YIELD CHANGE	(%)	Expert organisation
PRODUCTION COST CHANGE	(€/ha)	Expert organisation
LONG-TERM RESISTANCE EFFECTS	(t/ha)	Expert organisation
QUALITY EFFECTS	(€/t)	Expert organisation

COUNTRY-LEVEL DATA

The data inputs required to translate the farm-level income data to country-level data were sourced from either EUROSTAT, national statistical offices or the experts (Table 3). The analysis is based on a seven-year average (2010–2016), thereby limiting the effects of yearly variations in weather conditions and related pest pressure.

EU-LEVEL DATA

The EU-level effects are calculated only for the seven staple crops and are based on an extrapolation of the country-level results obtained in the 16 countries in scope. The data inputs required to translate these country-level to EU-wide effects are shown in Table 4.

DATA ANALYSIS

The next step in the study is to analyse the data inputs to determine what the socio-economic effects are at farm level, country level and EU level. The analysis is based on the following key assumptions:

***Table 3**: Overview of data sources for country level analysis per country and crop*

Indicator	Unit	Source
AREA	(ha)	Expert organisation; EUROSTAT; national statistical office
PRODUCTION	(t)	Expert organisation; EUROSTAT; national statistical office
EMPLOYMENT	(FTE)	EUROSTAT
PRODUCTION VALUE	(€)	EUROSTAT

***Table 4**: Overview of data sources for EU-level analysis per country and crop*

Indicator	Unit	Source
INCOME EFFECTS		
EU-28 AREA	(ha)	EUROSTAT
EU- 28 PRODUCTION	(t)	EUROSTAT
EU-28 PRODUCTION VALUE	(€)	EUROSTAT
SELF-SUFFICIENCY EFFECTS		
EU-28 IMPORTS	(t)	EUROSTAT
EU-28 EXPORTS	(t)	EUROSTAT
CARBON FOOTPRINT		
GHG EMISSIONS BY SOURCE SECTOR (SECTORS USED: AGRICULTURE; LIVESTOCK)	(tCO_2 e)	EUROSTAT
T CO_2 EQUIVALENT EMISSIONS FOR BIOMASS ON ONE HECTARE	57 tCO_2 e	IPCC Guidelines Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)
YEAR AMORTISATION TIME TO CONVERT ONE-TIME DEFORESTATION TO ANNUAL IMPACT	20 years	IPCC Guidelines Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)
EMISSIONS FROM FREIGHT TRANSPORT	14 g CO_2 e per km	Guidelines for Measuring and Managing CO_2 Emissions from Freight Transport Operations, ECTA
DISTANCE USA TO EU	7,895 km	Distancefromto.net

- The 75 active substances are compared to their best currently available alternative solutions in the farmers' toolboxes and the Good Agricultural Practices (including chemical, biological, mechanical and cultural practices);
- All substances are to be removed from the market at the same time and no other substances will be introduced over the next five years. Given lengthy R&D and approval processes, and the small number of pesticides in the pipeline, this might not be an unrealistic scenario;
- The various crops are studied in isolation; crop rotation (or any significant change in the rotations) or other changes in the production area have not been taken into consideration;
- Yield and variable costs per hectare are subject to change ceteris paribus; the utilised area and ex-farm price per crop are presumed fixed.

The process by which the data inputs are analysed is outlined in Exhibit 5. The basis for the country- and aggregated EU-level analyses is what happens at farm level; in other words, the socio-economic effects determined at the level of the average individual farm in a country/the EU are used to determine the country/EU-level effects.. As discussed in the introduction, the study aims to establish the impact of removing the 75 substances from the farmer toolbox by comparing current farmer incomes to the hypothetical situation of a restricted farmer toolbox. Throughout the report, the figures, tables and exhibits will refer to the current situation as "WITH" and the hypothetical situation as "WITHOUT."

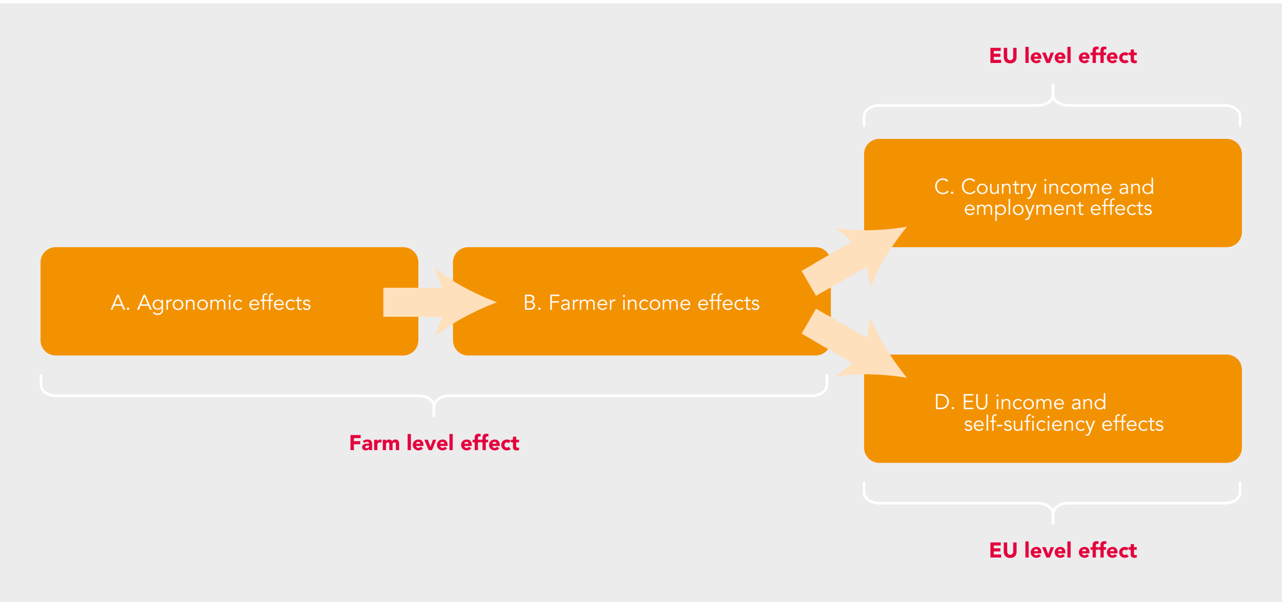


***Exhibit 5**: Data analysis process over three levels of analysis*

FARM-LEVEL EFFECTS

Agronomic effects
To estimate the yield changes, production cost changes, long-term resistance effects and quality effects, the experts in all 16 countries followed the approach outlined below per crop in scope (Exhibit 6):

1. *Identification of main threats:*

    a. Establish which weeds, fungi and insects are the main threats to the cultivation of a particular crop. For example, a common threat faced by potato farmers in Denmark is blight (a fungus).

2. *Correction for area treated:*

    a. Identify the share of the area where the pest affects crop cultivation. For example, insecticides are used in maize cultivation in the south of Romania much more than in the north due to high pressure from insects in southern Romania;
    b. Correct for area cultivated organically.

3. *Construction of new farmer toolbox:*

    a. Describe the current farmer toolbox, specifically chemical and non-chemical methods employed by the farmer to treat the pest;
    b. Identify which substances are on the 75 at-risk list and will be withdrawn from the current farmer toolbox;
    c. Identify which chemical and non-chemical alternatives are available to treat the pest. For example, an alternative to glyphosate for treating perennial weeds is mechanical weeding.

4. *Identification of changes in yield cost and quality*

    a. Quantify the change in yield (t/ha) as a result of using the new farmer toolbox;
    b. Quantify the change in production cost (€/ha) due to the use of the alternative treatment. For example, production costs can increase due to an increase in treatment frequency;
    c. Identify whether the quality of the crop will be affected with the new farmer toolbox (€/t). For example, in Finland, the new farmer toolbox will lead to the development of mycotoxins, thereby affecting the quality of the crop and the price at which it can be sold.

***Exhibit 6**: Overview of expert approach per crop*

d. Identify whether long-term resistance can develop with the new farmer toolbox due to the limited availability of alternative treatments.

This approach allows the expert to establish the effect of losing the 75 substances on: yield (t/ha); variable production cost (€/ha); quality effects (€/t); and long-term resistance effects (t/ha). With regards to yield effects, the experts distinguish between the short-term yield changes and the long-term resistance effects of not having the 75 substances available. The former refers to the immediate effects of shifting to a new farmer toolbox consisting of the best alternative substances. The latter refers to effects that might occur over time once weeds, fungi and insects have built up resistance to the fewer alternative substances. It should be noted that not all experts were able to provide estimations for long-term resistance effects or quality effects. These effects are therefore not used to calculate the effects on farmer incomes. Another important effect which has not been considered is the possible increase of pest pressure due to the restricted toolbox as well as fewer possibilities to control new pests resulting from climate change and invasive alien species.

We note that there was considerable variation in the level of detail that experts could provide for changes of production cost data, both across countries and across crops. Whereas for some crops in some countries, experts were able to itemise changes with a high level of granularity, in other cases they were only able to provide high-level estimates of how the total variable costs would change. We have intended to keep the approach followed for each country/crop combination as consistent as possible through one-on-one meetings with each of the responsible experts to check that the prescribed methodology was followed and to cross-examine the results in detail. But ultimately, the quality of the results relies on the judgement and estimations of the experts. Although different experts may reach different results for individual country/crop combinations, we are confident that the results present a fair and defensible aggregate picture due to the absence of systemic biases. This makes it likely that over and under estimations for individual country/crop combinations will be more or less in balance.

Farmer income effects

The profitability of a farm is best understood on a per hectare basis; how much does a farmer earn per hectare of the land he or she cultivates? In order to allow for comparisons of profitability across crops and countries, the profitability is expressed both in absolute figures (gross profit per hectare in €) and relative figures (gross margin per hectare in %). The gross profit per hectare earned by farmers within one country will differ greatly per crop. A specialty crop cultivated in greenhouses will often have a high gross profit per hectare. This is due to the high ex-farm price received by the farmer and the high yield per hectare. Cereals, on the other hand, have a relatively low gross profit per hectare because of their relatively low yield per hectare and lower ex-farm price. However, expressing profitability in terms of gross margin removes these effects, and allows for a better comparison between crops. To illustrate, lettuce farmers in Belgium have a high per hectare gross profit (€13,161 per hectare) when compared to Belgian maize farmers (€530 per hectare). However, they both operate at the same gross margin, approximately 40% per hectare. Note that the average farm size of a lettuce farmer is much smaller than the average size of a maize farm.

The study aims to capture the effects at the average farmer level. The average crop yields are therefore calculated based on the national crop production output figures and the national crop cultivation area (both of which are extracted from EUROSTAT). In doing so, the study accounts for variations in productivity per farm.

To calculate farmer profitability WITH and WITHOUT, the study assumes a stable ex-farm price; the farmer will receive the same price per tonne of crop both WITH and WITHOUT the 75 substances. Therefore, the potential quality effects and the effects a lower supply may have on price are not taken into consideration. The study considers immediate effects only in the profitability calculations. Please refer to Table 15 in Annex 1 for an overview of the calculations.

It is important to note that most farm-households in Europe are family farms. Many of these households earn additional off-farm income. When the WITHOUT alternatives mentioned above imply an increase of on-farm labour demand, it may negatively affect total household income. This effect is not considered in this study, however.

COUNTRY EFFECTS

Country income effects

At the country level, this study estimates the effects of a restricted farmer toolbox by calculating the loss of country revenue (production value) per crop and the loss of country production per crop. To understand impacts per crop at country level, the study translates the farm-level income changes to country level on the basis of two assumptions: a stable ex-farm price and a fixed utilised area. Please refer to Table 16 in Annex 1 for an overview of the calculations.

Country employment effects

The study provides an indicative insight into how farmer income losses translate to employment effects. The employment effects are categorised according to three risk levels, high, medium and low, which are assigned based on the gross margin change between the current toolbox (WITH) and a restricted toolbox (WITHOUT).

A first step is to establish the number of jobs in scope, i.e. how many persons are employed per crop studied. Once the number of jobs per crop has been established, the jobs are categorised according to their gross margin change: high risk >70% gross margin change; medium risk >30% and <70% gross margin change; low risk <30% gross margin change. Please refer to Table 17 in Annex 1 for an overview of the calculations.

EU-LEVEL EFFECTS

At EU level, the study focuses solely on the seven staple crops and relies on the experts' agronomic estimations collected from the 16 countries currently in scope to calculate the effects for the whole of the EU. As can be seen in Table 5, the 16 countries constitute an average 80% of total EU production per staple crop.

***Table 5**: Countries in scope used for EU-28 extrapolation for seven staple crops*

Crop	Share of total EU production	Countries in Scope
SUGAR BEET	85%	Austria, Denmark, France, Germany, Netherlands, Poland, Spain, Sweden, United Kingdom
GRAPES	93%	Austria, France, Greece Hungary, Italy, Romania, Spain
POTATOES	88%	Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Romania, United Kingdom
MAIZE	78%	Austria, Belgium, France, Germany, Hungary, Italy, Poland, Romania
BARLEY	62%	Denmark, Finland, France, Germany, Italy, Netherlands, Sweden, United Kingdom
WHEAT	77%	Austria, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Romania, Sweden, United Kingdom
OILSEED RAPE	84%	Austria, Denmark, Finland, France, Germany, Hungary, Poland, Romania, Sweden, United Kingdom

Income effects
As shown in Exhibit 5, farm-level effects form the basis of the calculations of the EU-level effects. Thus the first step is to analyse the effects at the level of the 'average' EU farmer per staple crop (please refer to Table 18 in Annex 1 for an overview of the calculations):

1. *Establish average EU farmer income per hectare WITH*

    a. Based on EUROSTAT data, calculate average EU yield and ex-farm price, and subsequent revenue;
    b. Based on data from countries in scope, calculate average EU production cost;
    c. Calculate average EU gross profit and margin

2. *Establish average EU farmer income per hectare WITHOUT*

    a. Based on countries in scope, calculate average yield and production cost changes
    b. Calculate average EU farmer revenue and production cost WITHOUT
    c. Calculate average EU gross profit and margin WITHOUT

In order to translate the effects for the average EU farmer to EU-28 effects, the study assumes a stable ex-farm price and a fixed utilised area per crop. This is a likely scenario for staple crops, given that there are other large producers of the seven crops outside of the EU. Assuming the ex-farm price for specialty crops remains stable is, however, less realistic. Lower yields for specialty crops may translate to higher prices, which could in turn offset the income effects experienced at farm level.

Self-sufficiency effects
The impact on EU-28 crop production levels is likewise assumed to affect EU self-sufficiency, whereby self-sufficiency is defined as the proportion of domestic consumption met from domestic production. Assuming that EU demand in both the WITH and WITHOUT scenarios remains constant, the loss of EU staple crop production (due to the yield changes) can lead to a gap between supply and demand. Please refer to Table 19 in Annex 1 for an overview of the calculations.

To continue to meet demand, the EU can either choose to a) import the crops from abroad or b) convert additional EU land for cultivation. The choice between either of these two scenarios will have an impact on two broad environmental indicators: carbon footprint and land use. For both scenarios, the study establishes the effects for the WITH and WITHOUT situations.

In the current situation, WITH the 75 substances available, greenhouse gas (GHG) emissions are the result of the use of farm inputs (the use of fertiliser and diesel, and energy inputs for irrigation, drying and storage).

In the first WITHOUT scenario, the seven staple crops are assumed to be imported from the United States. It is assumed that the crop yield and farm inputs required per hectare in the US are the same as in the EU. Additionally, it is assumed that CO_2 emissions arising from farm inputs and land conversion in the US will be the same as in the EU. Importing the staple crops to continue to meet demand will lead to GHG emissions from the following activities: land conversion, farm inputs used on additional land required to meet EU demand, and transport from the US to the EU.

In the second WITHOUT scenario, additional land within the EU is cultivated to compensate for the lower yields. This will lead to GHG emissions from the following activities: land conversion and farm inputs used on converted land.


03

EU-Level Impact: Staple Crops

European farmers rely on a varied toolbox to protect their crops and ensure stable yields and incomes. They have at their disposal: planting and crop rotation choices, seed and variety selection, and the use of crop protection products. The crop protection products form an integral component of the farmer toolbox. Removing the 75 substances will consequently place pressure on the economic viability of the cultivation of crops, with farmers facing lower yields and higher costs.

To understand the effects of a restricted toolbox on farmer yields and costs, experts in 16 EU countries were consulted. At the EU level, the study focuses solely on the seven staple crops and relies on the experts' agronomic estimations collected from the 16 countries currently in scope to calculate the effects for the whole of the EU. The number of countries per staple crop in which experts were consulted ranges from six countries for grapes to twelve countries for wheat. The farm-level data for sugar beets, grapes, potatoes, maize, barley, wheat and OSR covers between 62% and 93% of the total EU production per crop.

For the seven staple crops, the currently available farming toolbox allows the EU to produce an additional 102 million tonnes and generate an additional €14,081 million value per year than if the 75 at-risk substances were not included.

- Barley, wheat, oilseed rape, maize and potato farmers could face 10 to 20% lower yields, while sugar beet and grape farmers could lose upwards of 20 to 40% of their production;
- EU staple crop farmers face an average production cost increase of 12% per hectare;
- Lower yields and higher production costs will lead to reduced farmer profitability. The gross margin per hectare enjoyed by the average EU staple crop farmer will drop to 23% from 44%.

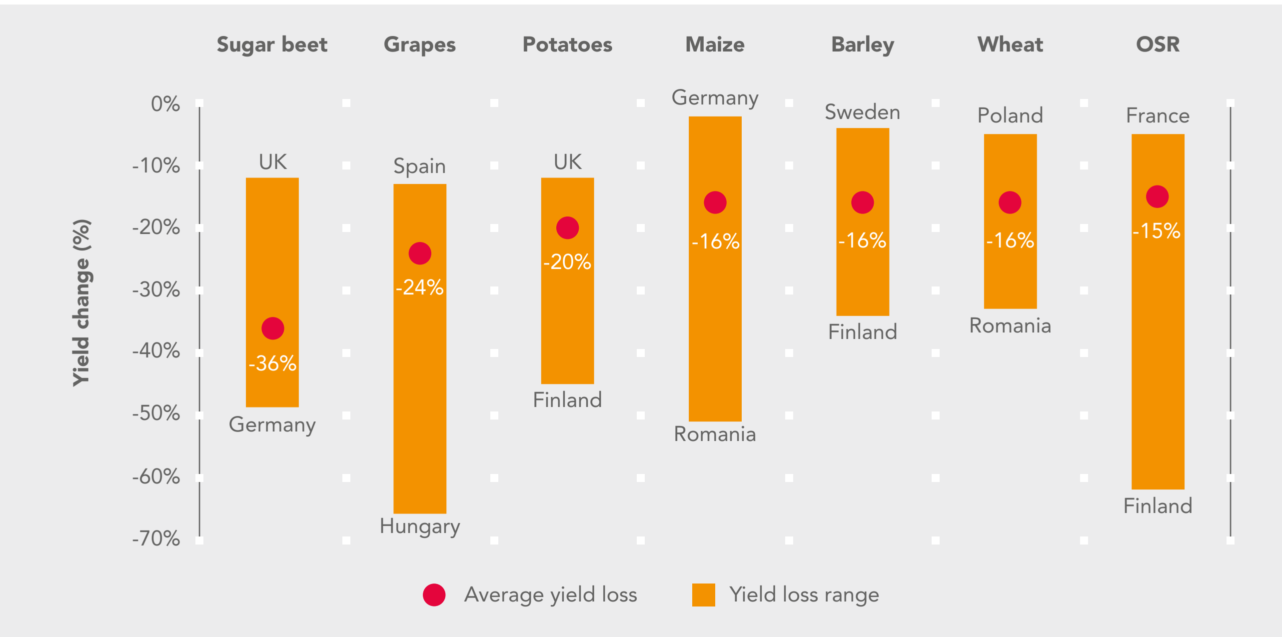


***Exhibit 7**: Overview of short-term yield effect range provided by experts for all countries in scope*

***Table 6**: Short-term yield and variable cost changes at extrapolated EU level*

Crop	Ex-farm price (€/t)	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
		Yield			Production Cost		
POTATOES	180	31.5	−20%	25.3	2,599	263	2,862
GRAPES	561	7.4	−24%	5.6	1,728	311	2.039
SUGAR BEET	33	72.1	−36%	46.4	1,259	295	1,555
OSR	427	3.1	−15%	2.7	686	69	755
WHEAT	188	5.6	−16%	4.7	626	39	665
MAIZE	176	7.0	−16%	5.8	895	21	916
BARLEY	183	4.7	−16%	4.0	558	30	588

At the rate of current EU demand for the seven staple crops, the loss of the 75 substances will lead to a gap between EU production and EU demand. The EU will lose self-sufficiency in all seven staple crops. To continue to meet current levels of demand, the EU can either choose to a) import the crops from abroad or b) convert additional land in the EU for cultivation.

a. To continue to meet current levels of demand, the EU can become a net importer of all seven staple crops:
   - The EU will likely be dependent on imports for approximately 20% of its staple crop demand;
   - GHG emissions resulting from importing the seven staple crops will be equal to 42 million tonnes of CO2 equivalent

b. To continue to meet current levels of demand, the EU can alternatively convert additional land for crop cultivation:[13]
   - An additional 8.4 million hectares of land in the EU must be converted for crop cultivation in order to meet local demand;
   - GHG emissions resulting from the additional land cultivated in the EU will be 32 million tonnes of CO2 equivalent.

13 *It should be noted that the likelihood of this scenario is very low. Land in the EU is scarce, and this is even more so the case for arable land. The effects of this scenario are an illustration of hypothetical effects.*

EU INCOME EFFECTS

Farmers in the different European countries must contend with very different climates, pest pressures and regulatory environments. The heterogeneity of yield estimations provided by the experts thus reflects the very different environments European farmers must operate in. Cereal farmers in Finland rely on crop protection products to ensure stable production despite very short growing seasons and unpredictable annual weather patterns; the main threat faced by maize farmers in southern Romania is insects; and the strict regulatory environment in Denmark has resulted in low pesticide dependency amongst farmers. As can be seen in Exhibit 7, there is a large variation in the estimated yield losses per country and per staple crop.

To estimate what the income effect of a restricted toolbox will be on staple crop production for the whole of the EU-28, the yield and cost change estimations provided by the consulted experts are extrapolated (Table 6). With the 75 at-risk substances in their toolbox, EU farmers enjoy higher yields and lower costs. A restricted toolbox will,

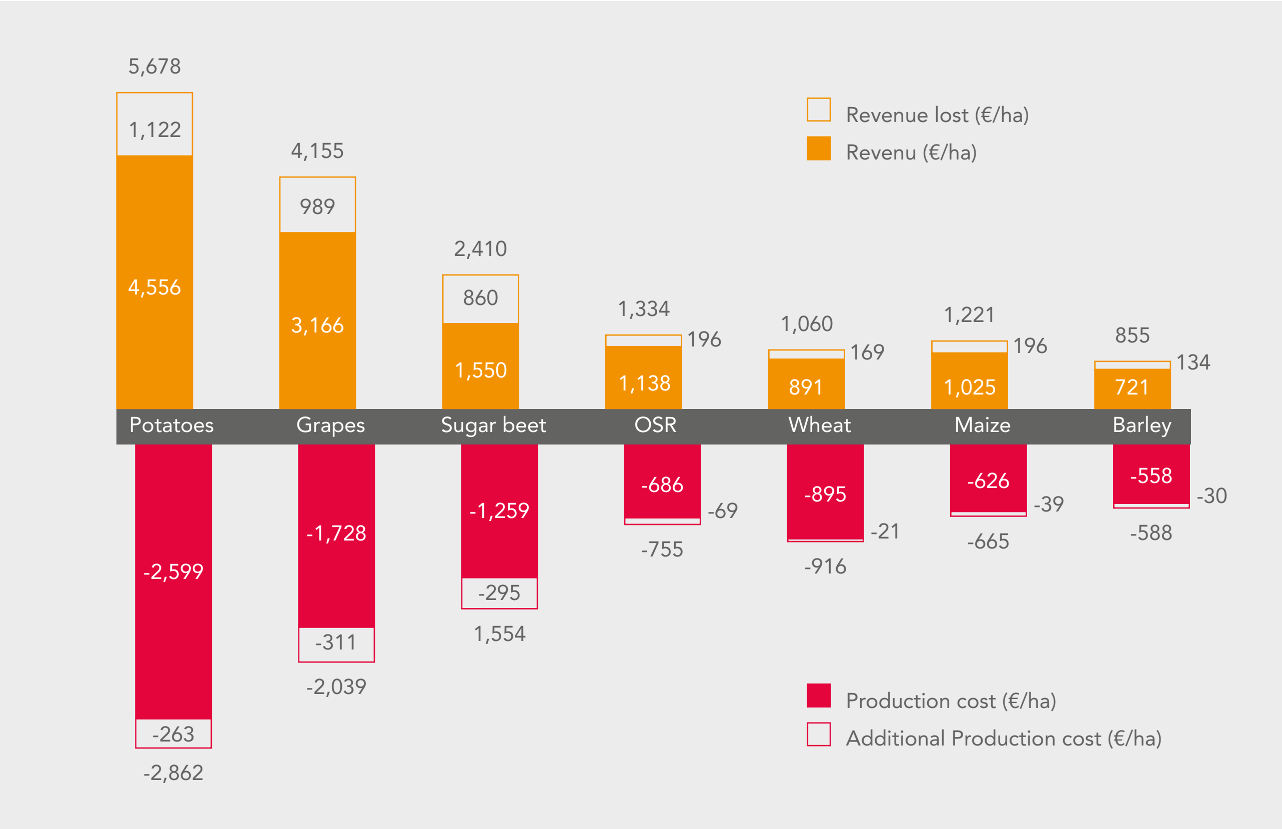


***Exhibit 8**: Revenue lost and additional production cost WITHOUT at the average EU farm for the seven staple crops (€/ha)*

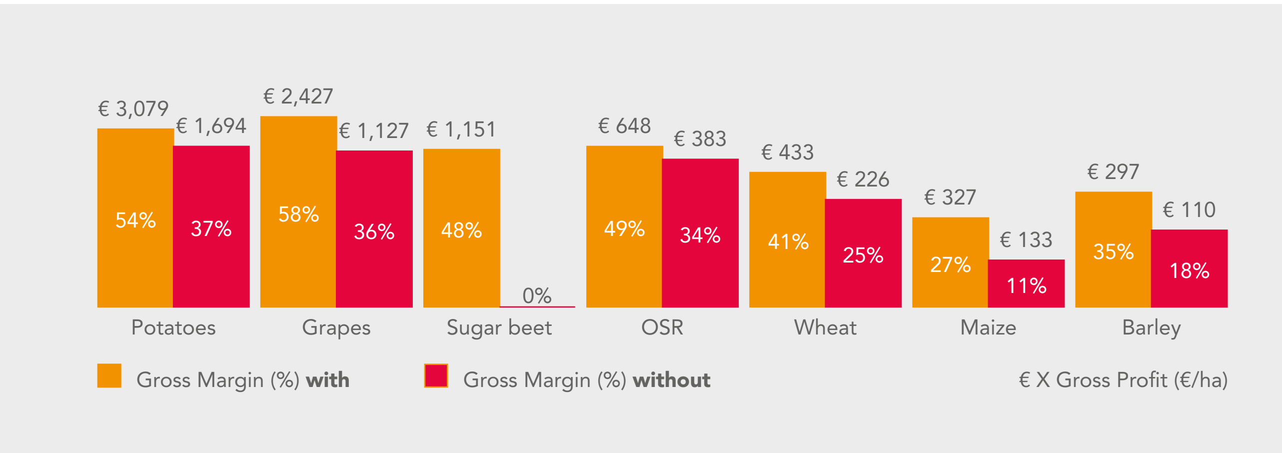


***Exhibit 9**: Income effects at EU farm level WITH and WITHOUT (in €/ha)*

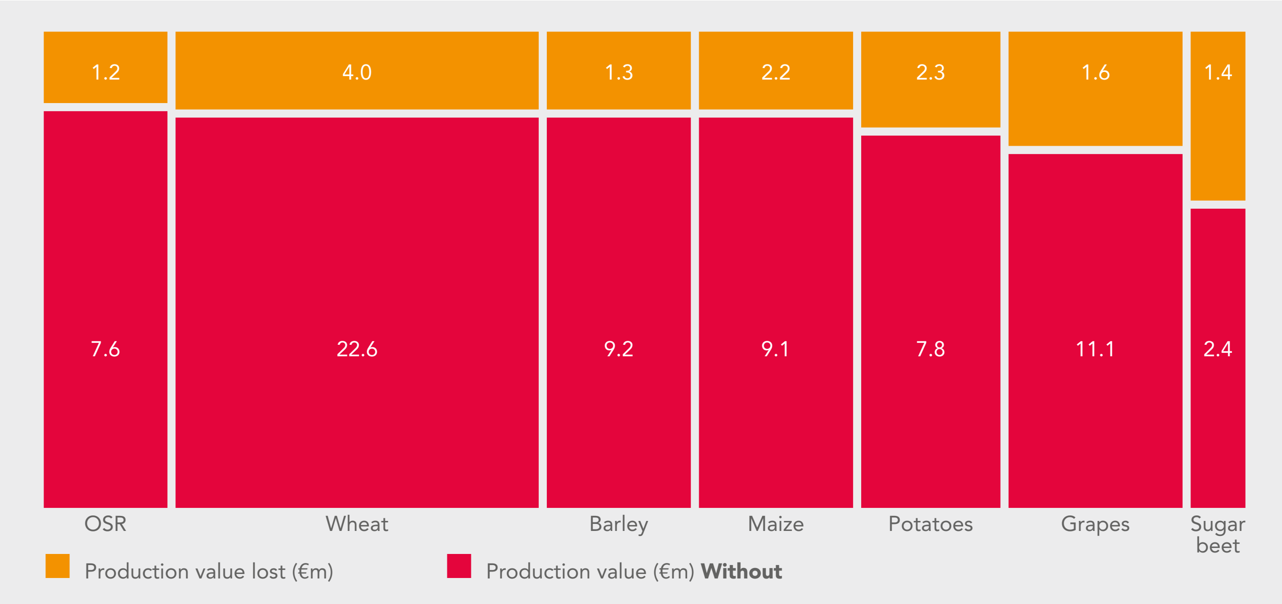


***Exhibit 10**: Total EU extrapolated production value for seven staple crops (in € billion)*

however, drive down yields and increase production costs (Table 6). EU sugar beet farmers face the highest yield loss at 36% and a high production cost increase at 23% (or €295) higher costs per hectare. EU OSR farmers face the lowest yield decrease: −15% or −0.4 tonnes per hectare, and EU maize farmers face the lowest production cost increase: 2% or €21 per hectare.

The short-term yield and production cost changes will affect farmer profitability, expressed both in terms of gross profit (€/ha) and gross margin (%). Assuming a stable ex-farm price, the estimated yield changes will immediately affect the EU farmer's revenue per hectare (Exhibit 8). To illustrate, the 20% loss in yield faced by EU potato farmers without the 75 substances in their toolbox translates into a 20% or €1,122 loss in revenue per hectare. The estimated production cost change per crop will increase the cost of cultivating the crops per hectare by the same amount (Exhibit 8).

These changes to EU farmers' per hectare revenue and cost will affect their profitability (Exhibit 9). With the current toolbox at their disposal, the average EU staple crop farmers are able to operate with a positive gross margin, ranging from an average 27% per hectare for maize farmers to 58% for grape farmers (Exhibit 9).[14] A restricted toolbox will, however, diminish revenues and increase costs, thus reducing profitability from both sides. Despite the loss of the 75 substances, most EU staple crop farmers will still be able to operate with a gross profit. On average, OSR farmers in the EU face the smallest per hectare gross margin loss: from 49% to 34%. The greatest income pressure is on EU sugar beet farmers, with the average farmer operating at a loss without the 75 substances at their disposal. The negative gross profit (−€5 per hectare) means that sugar beet cultivation would become economically unviable if no better alternatives are found.

The yield losses and cost increases at the EU farm level will translate into effects at the regional level. Assuming a constant acreage under agricultural production, the EU stands to lose approximately 102 million tonnes of staple crop production annually with a restricted toolbox.

The loss of 102 million tonnes of staple crop production annually is equal to a loss of €14 billion in production value. The total threat to production value for cereal crops is approximately €7.5 billion or 54% of total value loss. With the current toolbox at the EU farmer's disposal, the average annual production value of the seven staple crops is approximately €83.9 billion. A restricted toolbox will lead to a depletion of approximately 17% of agricultural production value at the EU level.

*14 Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)−(costs)) / (revenue) = ((ex-farm price * yield)−(costs)) / (ex-farm price * yield).*

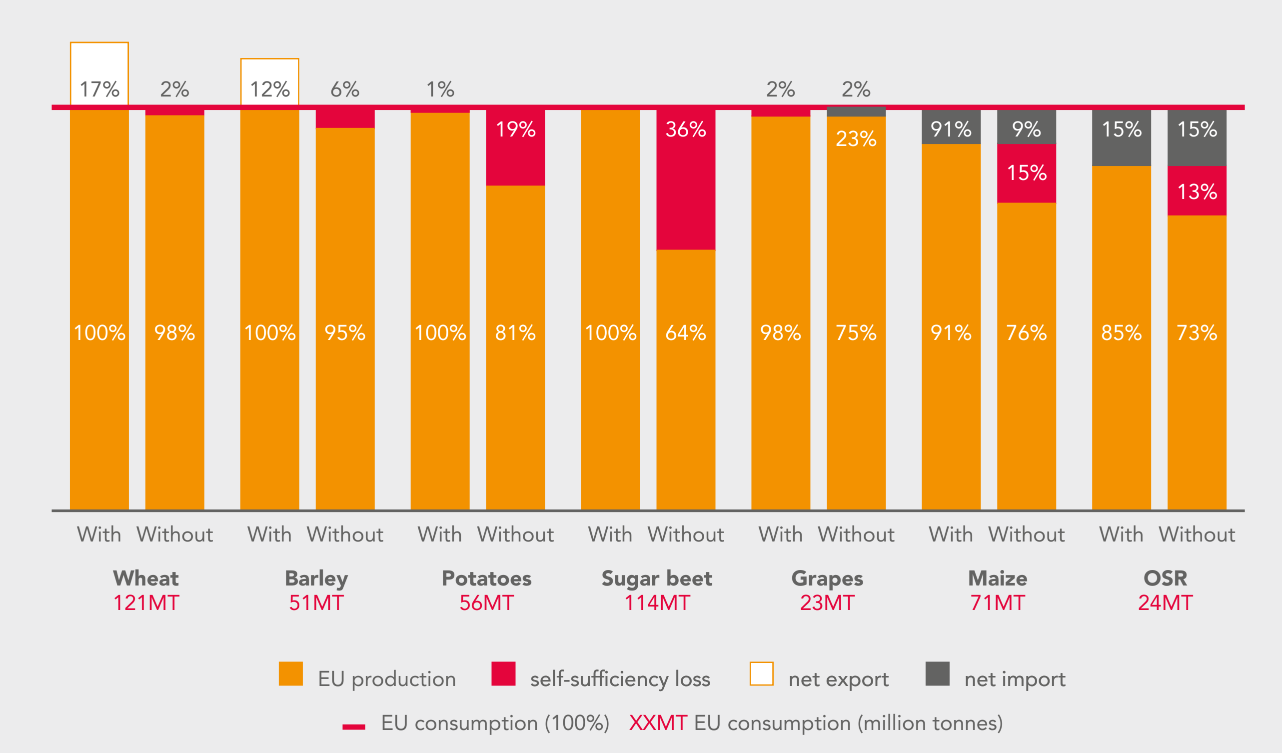


Exhibit 11*: Trade balance shift for seven staple crops (in million tonnes) Exhibit 10: Total EU extrapolated production value for seven staple crops (in € billion)*

EU SELF-SUFFICIENCY EFFECTS

A restricted toolbox will affect the extent to which EU production can meet EU demand. Restricting the EU farmer's toolbox will drive down yields (Table 6) and lead to an estimated loss of 102 million tonnes in annual production of the staple crops in the EU. This translates not only into a regional income loss (as discussed in 3.1), but will also affect the EU's level of self-sufficiency.[15] The EU is largely self-sufficient in five of the seven staple crops. HoweverThe loss in yield and subsequent annual production loss will lead to a regional production deficit. To maintain current levels of self-sufficiency, the EU can either choose to a) import the crops from abroad or b) convert additional EU land for cultivation.

TRADE EFFECTS: IMPORTING STAPLE CROPS FROM ABROAD

As can be seen in Exhibit 11, the EU is currently a net exporter of wheat, barley and potatoes. Approximately 20 MT of wheat, 6 MT of barley and 0.3 MT of potatoes are produced in excess of EU demand per year. The assumption here is that the excess production is exported to countries outside of the EU. The EU's demand for sugar beets and grapes is largely met by local production. Of the 113.9 MT of sugar beet consumed annually in the EU, 113.8 MT (or 99.9%) can be met by local production. Similarly, of the 23.2 MT of grapes consumed annually in the EU, 22.7 MT (or 98%) can be met by local production. The EU's production of maize and OSR, even with the currently available toolbox, must be supplemented by imports to meet EU demand.

Without the 75 substances in the EU farmer's toolbox, the EU will no longer be self-sufficient in its production of wheat, barley, potatoes, sugar beets and grapes. In order to meet local demand, the EU would have to import 2 MT of wheat, 3 MT of barley, 11 MT of potatoes 41 MT of sugar beets, and 5 MT of grapes. Moreover, a restricted toolbox will lead to maize imports increasing from 7 MT to 17 MT and OSR imports increasing from 3.5 MT to 6.6 MT per year. EU staple crop imports will have increased from 11 MT to 75 MT.

15 *Self-sufficiency is defined as the proportion of domestic consumption met from domestic production*

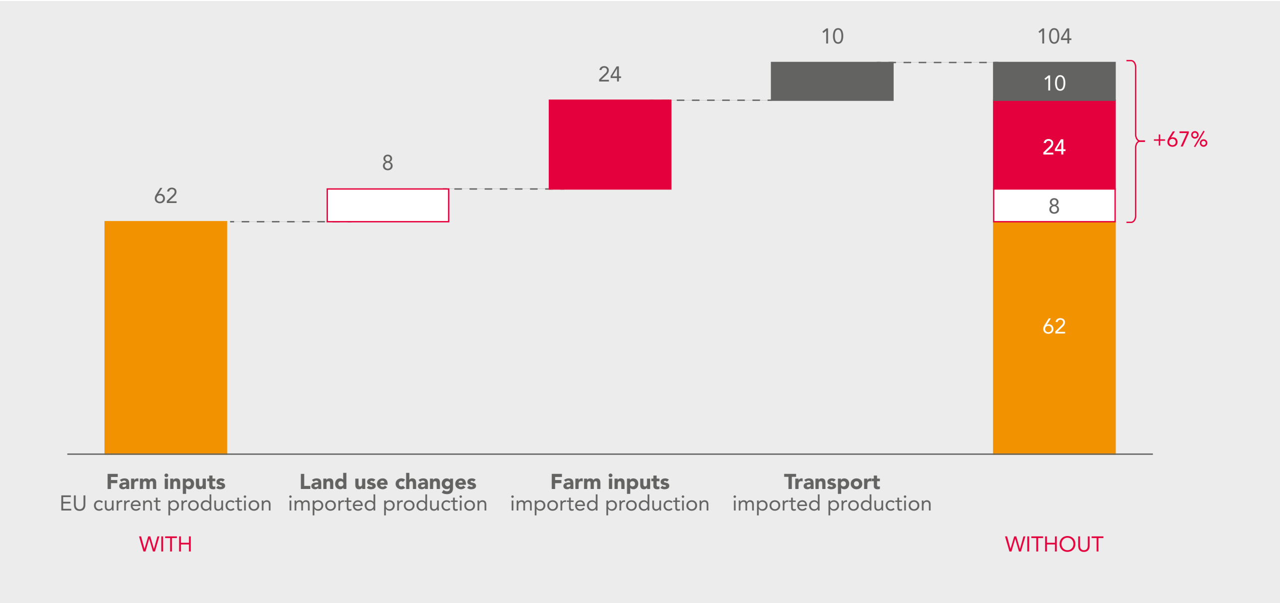


***Exhibit 12**: Carbon footprint of EU's seven major staple crops (in million tonnes of CO_2 equivalent*

Climate change is currently a salient issue, receiving widespread political and public attention both at the EU and country levels. Countries within the EU are committed to mitigating climate change and reducing their carbon footprint. The total annual carbon emissions of the EU add up to around 4,600 million tonnes of CO_2 equivalent. The agricultural sector emits almost 10%, or 443 million tonnes, of these emissions, of which non-livestock agriculture emits approximately 295 million tonnes. GHG emissions from the production of crops arise from the use of farm inputs that include the use of fertiliser and diesel, and energy inputs for irrigation, drying and storage (Exhibit 12). It is estimated that emissions arising from the production of the seven staple crops add up to 62 million tonnes CO_2 equivalent per year. However, importing the 75 MT of staple crops from outside of the EU to meet local demand will lead to an additional 42 million tonnes of CO_2 equivalent of GHG being emitted. It is assumed three activities will result in the emission of GHG in the exporting countries: conversion of land for cultivation, farm input usage and transport of the crops to the EU.[16]

16 *As per the first report, this scenario assumes that, to meet EU import demand, the US will have to convert additional land. Furthermore, we assume that CO_2 emissions arising from farm inputs and land conversion in the US will be the same as in the EU.*

LAND USE EFFECTS: CULTIVATING ADDITIONAL LAND IN THE EU

Land in the EU is a precious commodity. The EU-28 is comprised of some of the most densely populated countries in the world, and farmland competes against both urban, environmental and infrastructure needs. Farmers in the EU-28 cultivated 178.8 million hectares of land (the utilised agricultural area) in 2016. This represents 40% of the total land area of the EU-28. The key staple crops—wheat, barley, maize, sugar beets, oilseed rape, potatoes and grapes—make up 59.7 million hectares of the total area used for agriculture.

As previously discussed, the loss of the 75 substances from the EU farmer's toolbox will lead to a supply deficit. The excess EU demand can be met either through imports or, alternatively, by making more land in the EU available for cultivation. Assuming that the yield per staple crop of the additional land will be the same as the average EU yield without the 75 substances, an additional 8.4 million hectares would need to be cultivated to meet EU demand (Exhibit 13). This figure is comparable to the sum of the area cultivated for crops in Sweden, Finland and Austria. It should be noted that the likelihood of this scenario is very low. Land in the EU is scarce, and this is even more so the case for arable land. The effects of this scenario are provided merely as an illustration of hypothetical effects.

Although biodiversity and environmental impacts are outside the scope of this study, it is important to state here that the main determinant of the impact that agriculture has in these areas is whether or not land is being utilized for agricultural purposes. Per hectare, organic or chemical pesticide-free agriculture will likely have a less direct negative impact on biodiversity than conventional agriculture. But the lower yields associated with it, and thus the larger area needed for cultivation of the same production volume, means that more land under organic or chemical pesticide-free agriculture is not necessarily positive for biodiversity [17] and is furthermore likely to emit more greenhouse gasses [18].

Converting additional land for the cultivation of the seven staple crops will affect the amount of GHG that is emitted by the agricultural sector. The higher GHG emissions are the result of land conversion and the additional farm inputs required. Converting the 8.4 million hectares of land for agricultural cultivation will lead to an increase in emissions of 8 million tonnes of CO_2 equivalent. In addition, the use of fertiliser and diesel, and energy inputs for irrigation, drying and storage on this land will lead to an additional 24 million tonnes CO_2 equivalent of GHG emissions. If the local demand for staple crops is met by additional local production, GHG emissions in the EU will be 32 million tonnes of CO_2 equivalent higher (Exhibit 12).

17 *Farming without plant protection products: Can we grow without using herbicides, fungicides and insecticides? Panel for the Future of Science and Technology, European Parliamentary Research Service, Scientific Foresight Unit (STOA), March 2016*

18 *https://www.nature.com/articles/s41467-019-12622-7*

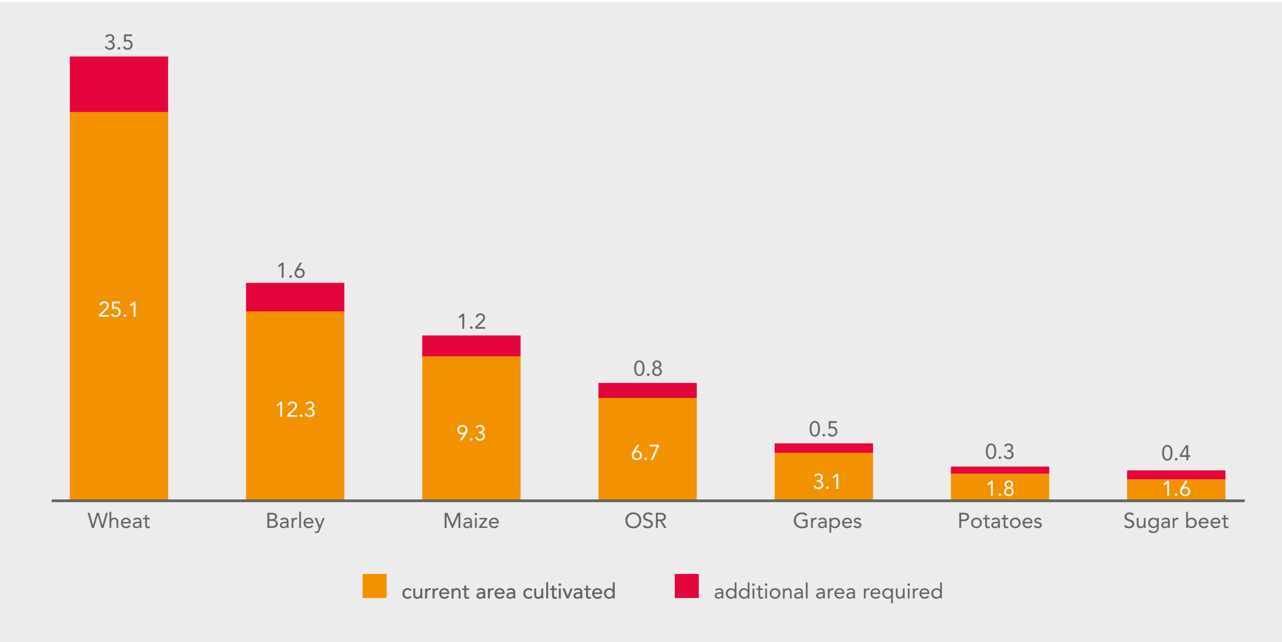


***Exhibit 13**: Land use of EU's seven major staple crops (in million hectares)*


04

Country-Level Impacts

For the 16 countries and 45 crops in the scope of this study, an estimated 1.3 million jobs are at high risk of being lost if the 75 at-risk substances are removed from the EU farmer's toolbox. Of the 1.1 million jobs in scope in Phase Two countries, 668,000 jobs are at high risk of being lost.

EMPLOYMENT EFFECTS

The availability of the 75 substances in the EU farmer's toolbox plays an important role in the economic viability of the cultivation of the crops in scope. The economic viability of a sector refers not only to the annual margins and profits incurred, but also to whether or not the sector can provide a stable source of employment. However, the role the agricultural sector plays in the economy and, specifically, as a source of employment differs per country.

In this study, including both Phase One and Phase Two, we cover 16 EU countries and 45 crops. Of the approximately 5.4 million jobs dependent on crop agriculture in the EU, an estimated 2.4 million fall within the scope of this analysis. Building upon the previous report, we distinguish between three risk categories: high, medium and low. The 45 crops in scope are assigned a risk category based on the gross margin change between the current toolbox and a restricted toolbox.[19] Without the 75 at-risk substances in the EU farmer's toolbox, over 1.2 million jobs are at high risk of being lost (Exhibit 14). Furthermore, 0.6 million jobs face a medium risk, and 0.5 million jobs face a low risk of being lost.

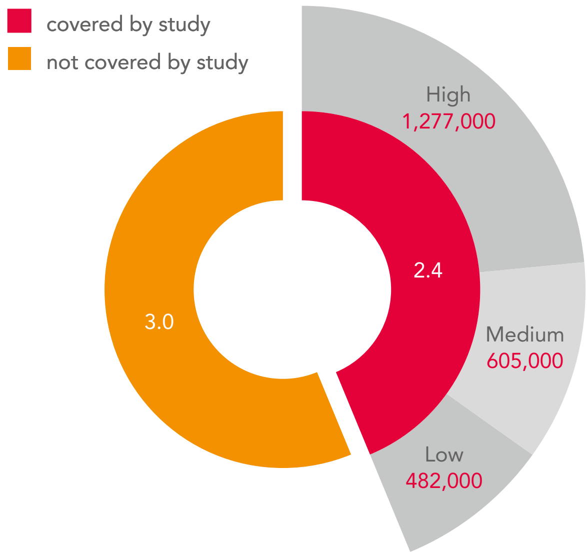


***Exhibit 14**: Dependency of jobs in crop agriculture on the current toolbox*

19 *High = >70% GM change; Medium = 30 – 70% GM change; Low = <30% GM change.*

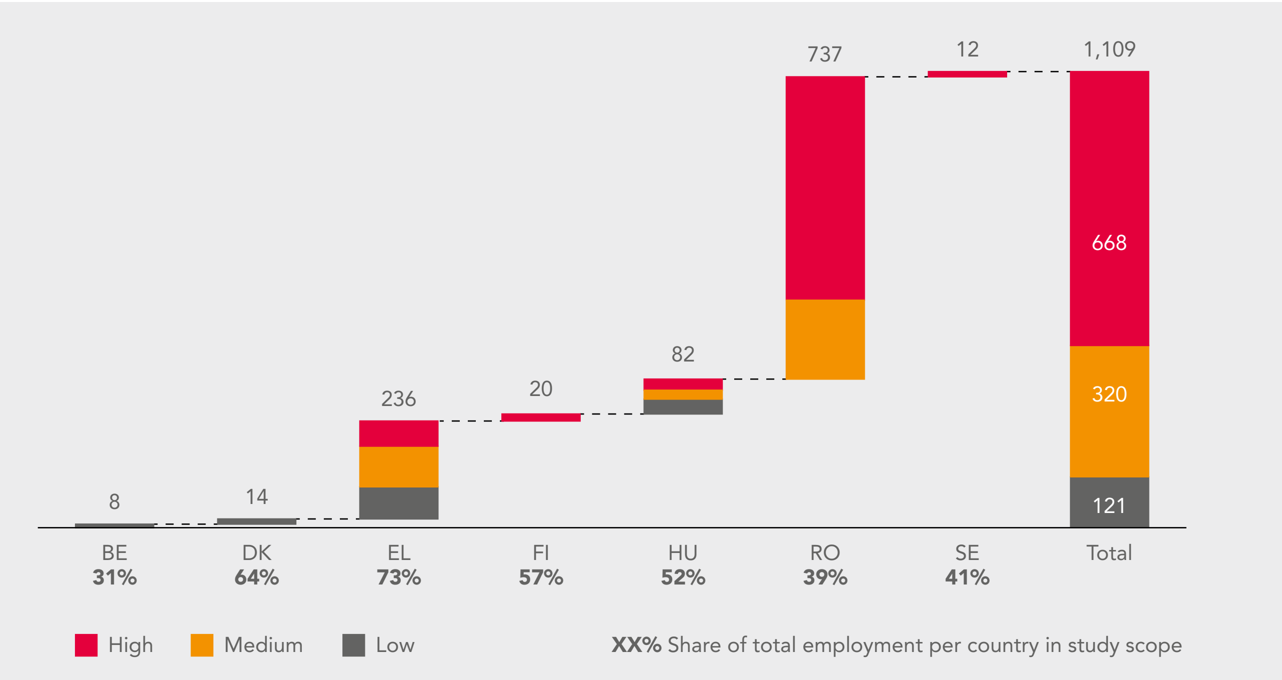


***Exhibit 15**: Job dependency for Phase Two countries (in thousands)*

Farm structures, labour productivity and therefore the level of employment in agriculture for the countries in scope vary greatly. In Romania and Greece, the average farm size is less than five hectares; most farms are family-owned and run, and more than a third of farmers are over 64 years of age. By contrast, in Denmark, average farm size is over 65 hectares, and less than a quarter of farmers are over 64 years. In Romania, this study covers only an estimated 39% of total agricultural employment in the country. However, given the relatively high level of agricultural employment in the country and low level of labour productivity in the agricultural sector, the jobs dependent on the crops in scope are estimated at 737,000 (Exhibit 15). This, in combination with the highly negative gross margin changes for the crops in scope in Romania, means that over 80% of all jobs at high risk of being lost are Romanian agricultural jobs (about 540,000). Conversely, while the study covers almost two-thirds of Danish agricultural employment, there are no jobs at high risk of being lost, and only about 3,000 jobs are at medium risk of being lost.[20]

20 These results differ slightly from the employment results published in the first ECPA Low Yield Report, because the results were updated from a five-year average (2009 to 2013) to a seven-year average (2010 to 2016).

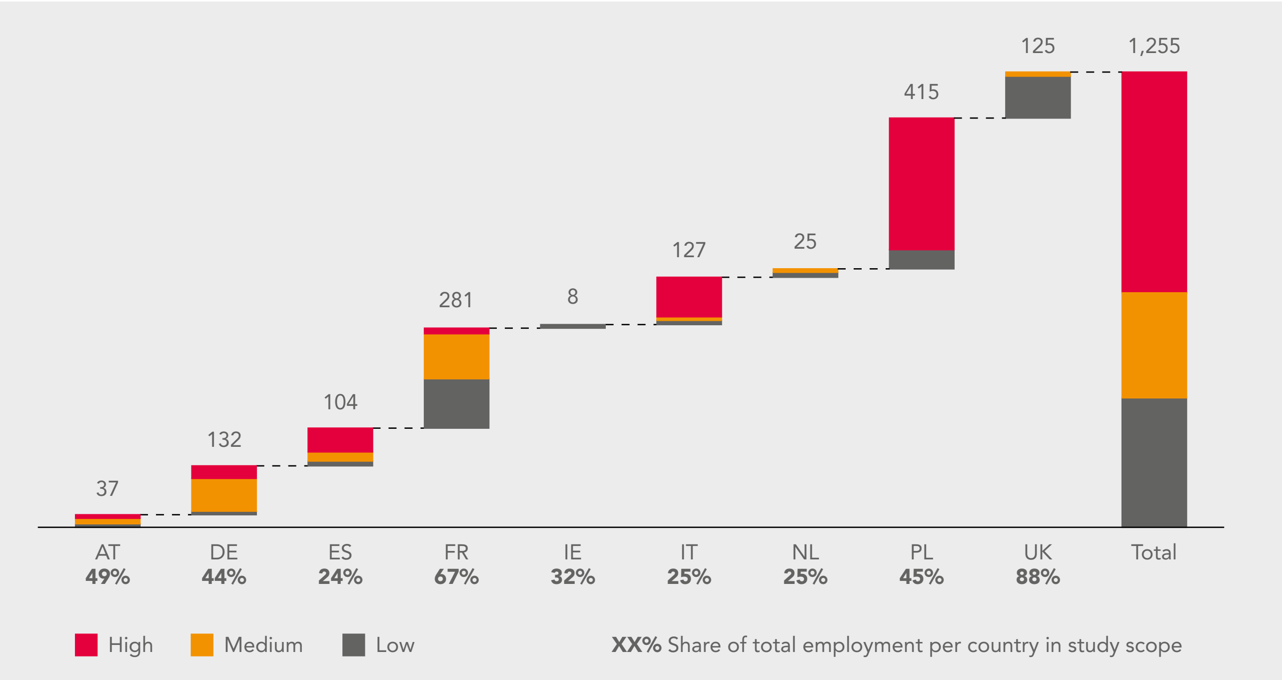


***Exhibit 16**: Job dependency for Phase One countries (in thousands)*


5

Belgium

For two key staple crops, the currently available farming toolbox allows Belgium to produce an additional 1,021,000t and generate an additional €120 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 234,000t of output and €89 million would be at stake. Further results include:

- In the short run for the crops in scope, Belgian farmers will lose on average 17% of their yield with a restricted toolbox;
- Variable production costs for the crops would increase by up to 10% per hectare;
- The average gross margin per hectare enjoyed by the Belgian farmer will drop by −63%.
- Belgian crop agriculture provides approximately 27,000 direct jobs, of which 8,200 depend on the crops covered by the study.

AGRICULTURE IN BELGIUM

Agriculture in Belgium contributes on average 0.8% to GDP and 0.9% to national employment,[21] indicating relatively low economic importance. Similar to trends in other EU countries, farming is not a preferred vocation for young Belgians. According to the European Commission, between 2005 and 2013, the number of agricultural holdings in Belgium fell from 51,540 to 37,760. The percentage of farmers below 44 years of age fell from 31% to 19%. A main concern of the Belgian farmer is income security; income in the Belgian agricultural sector is much more volatile than the wages and salaries in other industries.[22] One in five Belgian farmers reported high stress levels as a result of the income volatility.

The total average annual Belgian agricultural production value since 2010 has been approximately €3.6 billion. The crops covered in this study include two staple crops: maize and potatoes. Eight specialty crops are also included: apples, pears, strawberries, leeks, peas, lettuce, fresh green beans and carrots.[23] This study covers almost one-third of total Belgian crop production value (Exhibit 17).[24]

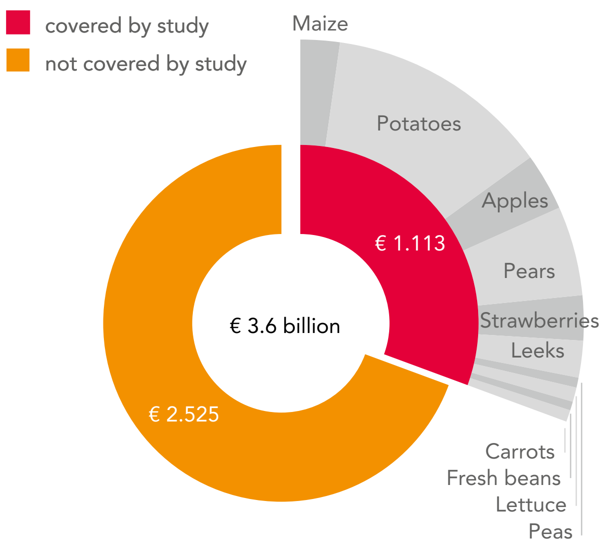


***Exhibit 17**: Belgian agricultural production value (in € million)*

BELGIAN FARM-LEVEL EFFECTS

Belgian farmers currently have 59 of the 75 at-risk substances in their toolbox.[25] The availability of these 59 at-risk substances affects two key revenue and cost determinants: yield and production cost (Table 7).

21 EUROSTAT (2018).

22 European Commission (2016).

23 For leeks, an average derived from industry processing and the fresh market is used for further calculations.

24 The majority of Belgian agricultural value comes from the production of cereals and sugar beets.

25 Two of the 59 substances, linorum and iprodine, were withdrawn this year. Given that the study began before the substances were withdrawn, this study treats them as part of the Belgian farmer's current toolbox.

In 2014, Belgium farmers used 3 million kilograms of pesticides, with the largest amount used for the production of potatoes (30%) and the production of fruits (23%). Belgian farmers must contend with weather volatility and particularly rely on fungicides during periods of heavy rainfall. Subsequently, fungicide usage in Belgium, when measured in kilograms, is highest at 45%, followed by herbicide usage (23%).[26] These numbers represent the crop production in Flanders only. However, since Flanders is responsible for 80% of crop production,[27] these results can be interpreted as being indicative of Belgium as a whole.

Of the two staple crops in scope, Belgian maize farmers benefit the most from the currently available toolbox. Having a complete toolbox available allows them to harvest approximately 29% more tonnes per hectare. Maize farmers are most impacted by weeds, and the removal of the at-risk herbicides will lead to an estimated 27% loss in yield. Potato farmers, also facing high weed pressure, enjoy 21% higher yields with the current toolbox. For specialty crops, the currently available toolbox allows for 4% higher yields for apple cultivation and up to 33% higher yields for carrot cultivation. In contrast to the other crops in scope, the Belgian pea farmer is not affected by the loss of the 75 substances. In Belgium, peas are an extensive crop, requiring minimal pesticide usage. Moreover, enough efficacious alternatives are available should the 75 substances be phased out.

Belgian farmers without the current toolbox at their disposal face increased production costs, ranging between €26 per hectare for maize and €3,160 per hectare for strawberries. Belgian potato farmers face the highest relative cost hike. This increase is largely the result of more expensive production inputs and more expensive pest treatment methods. For example, with the 75 substances at their disposal, potato farmers can make use of chemical weeding; removal of the substances, however, would mean they have to switch to mechanical weeding, which would increase costs by more than €780 per hectare. Another cost driver for potato farmers is high storage cost, which could increase by a further €170 per hectare.

***Table 7**: Short-term yield and variable cost changes* [26]

		Yield			Production Cost		
Crop	Ex-farm price (€/t)	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
STRAWBERRIES	2,400	24.2	−15%	20.5	23,500	3,166	26,666
LETTUCE	680	49.3	−25%	37.0	20,367	700	21,067
PEARS	575	35.6	−24%	27.2	8,286	280	8,566
LEEKS	410	39.1	−14%	33.4	6,737	413	7,149
APPLES	453	37.2	−4%	35.7	8,154	280	8,434
CARROTS	73	58.0	−33%	38.9	2,047	278	2,325
PEAS	323	7.2	0%	7.2	895	-	895
FRESH BEANS	200	11.7	−7%	10.8	1,032	300	1,332
POTATOES	118	47.6	−21%	37.8	4,782	953	5,735
MAIZE	116	11.3	−29%	8.0	785	26	811

26 Vlaanderen Landbouw & Visserij (2016).
27 USDA Foreign Agricultural Service (2017).
28 This data is provided by the experts.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 7% reduction in yield for beans and a complete loss of production for carrots.

Belgian farmers with the current toolbox are able to operate with a positive gross margin, ranging from an average 15% per hectare for potato farmers to an average 61% for pea farmers (Exhibit 18).[29] A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Belgian farmer. The loss of the 59 substances will result in a negative gross margin for Belgian potato farmers.

A stable ex-farm price is assumed when analysing the yield and cost changes on farmer incomes. However, the loss of substances can also affect quality of the harvested crop. A decline in quality can, in turn, impact the ex-farm price. The loss of thiophanate-methyl for leeks will lead to a lower quality grading. Cleaning the leeks instead will lead to additional labour costs, resulting in a quality effect of €5000 per hectare. Similarly, the loss of thiophanate-methyl will impact the quality of strawberries, pears and apples.

BELGIAN COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Belgian farm level will also impact the national-level. Assuming a stable annual production area, Belgium stands to lose approximately 1.3 million tonnes of crop production annually with a restricted toolbox.[30]

The loss of 1.3 million tonnes of crop production annually is equal to a loss of €209 million in production value (Exhibit 19). The total loss of production value for staple crops is approximately €120 million, or 58%, of total value loss. However, approximately a quarter of the value lost is due to production losses of two high-value crops: strawberries (€14 million) and pears (€43 million).

Crop protection products are an important component of a farmer's strategy to ensure stable yields and incomes. Although the removal of the 59 substances from the Belgian farmer's toolbox will not push gross profits below zero, the farmers of

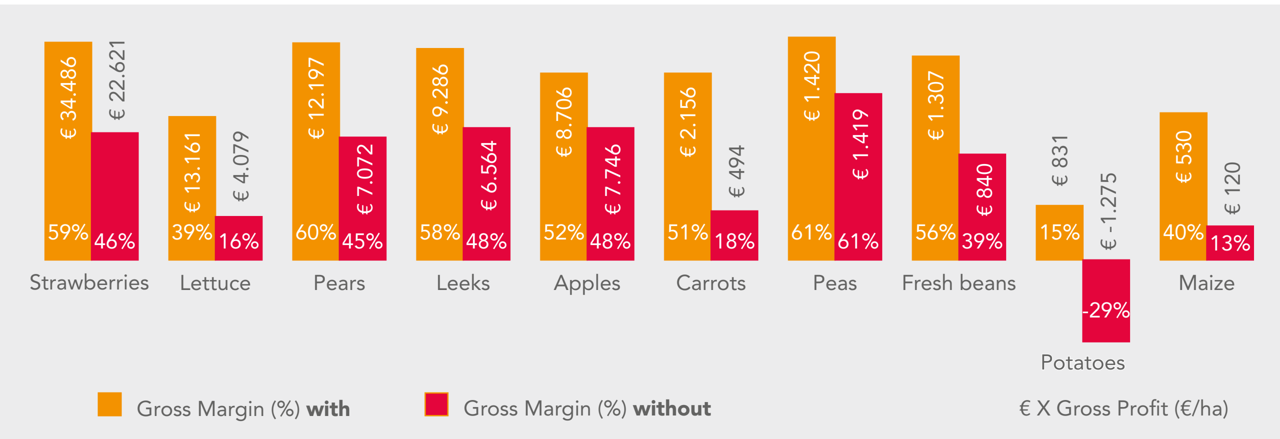


***Exhibit 18**: Income effects at farm level (in €/ha)*

29 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)−(costs)) / (revenue) = ((ex-farm price * yield)−(costs)) / (ex-farm price * yield).*

30 *For detailed crop production statistics, please refer to Annex 3.*

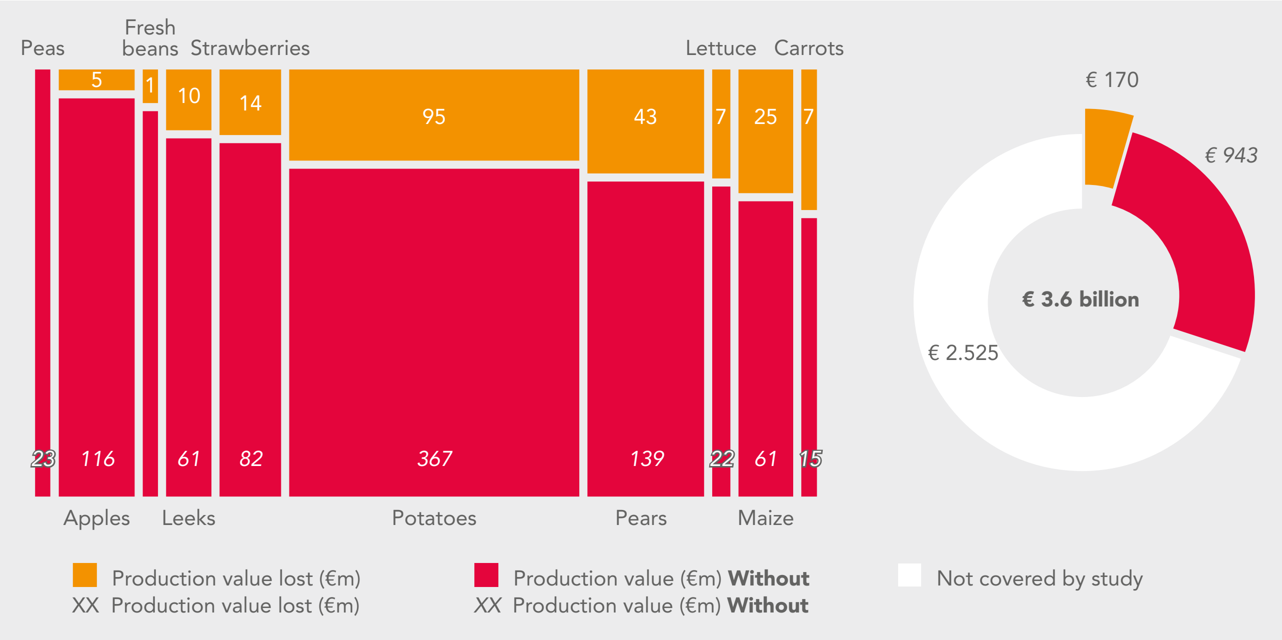
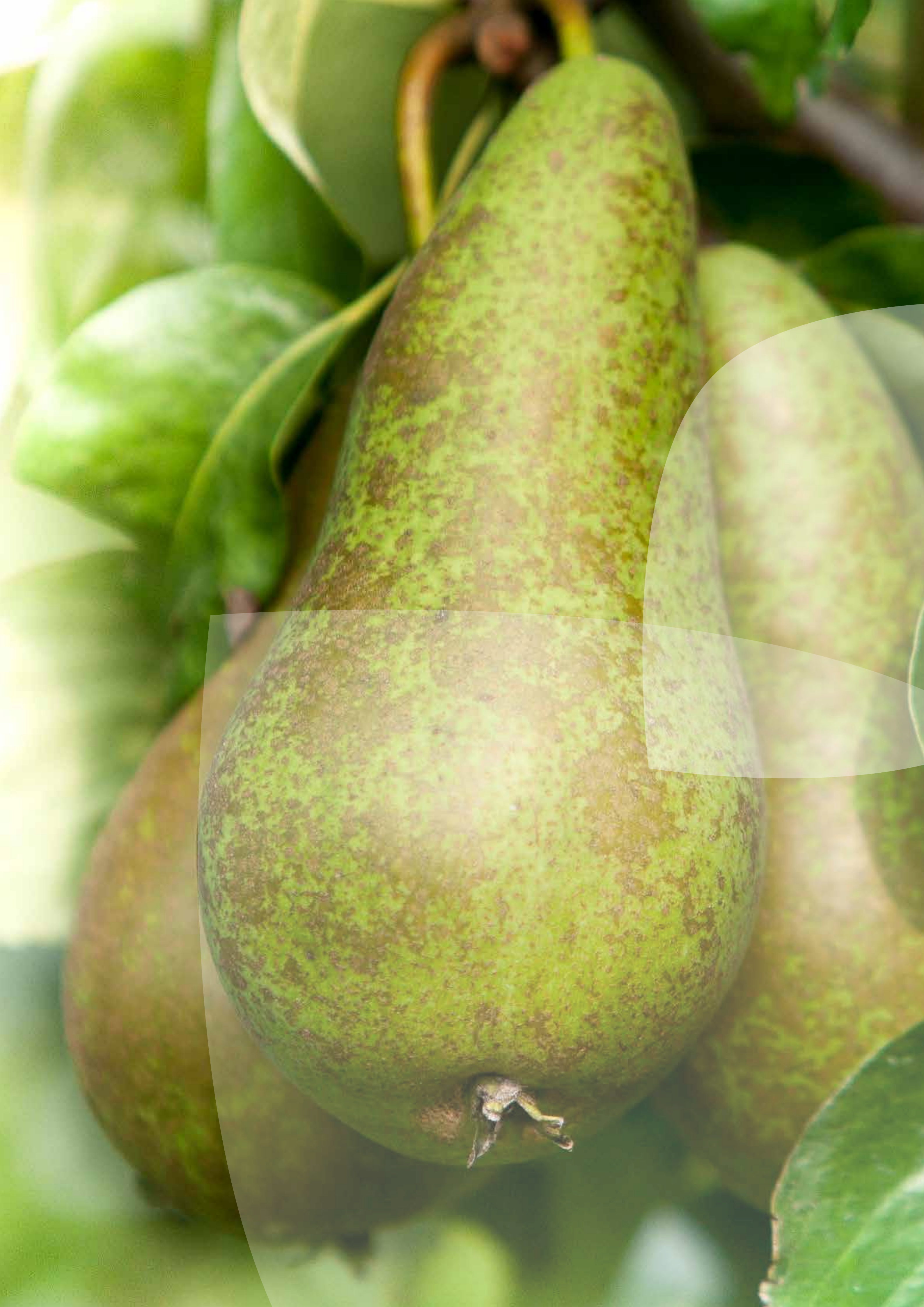


***Exhibit 19**: Total production value in scope (in € million), left; total production value (in € million), right*[29]

the crops in scope will face an average gross margin loss of 21 percentage points, ranging between a drop of 4 percentage points for apple farmers to 43 percentage points for potato farmers. Furthermore, a likely consequence of the limited toolbox will be a Belgian farmer less able to protect crops against increased weather volatility, such as heavy rainfall. These two developments have the potential to further exacerbate the stress levels of Belgian farmers and influence the labour-drain trend.

31 *Differences in totals are due to rounding.*



Denmark

For five key staple crops, the currently available farming toolbox allows Denmark to produce an additional 1,500,000t and generate an additional €212 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 78,000t of output and €9 million would be at stake. Further results include:

- In the short run for the crops in scope, Danish farmers will lose on average, 8% of their yield with a restricted toolbox;
- Variable production costs for the crops would increase by up to 9% per hectare;
- The average gross margin per hectare enjoyed by the Danish farmer will drop to 40%.
- Danish crop agriculture provides approximately 22,000 direct jobs, of which 14,200 depend on the crops covered in the study.

AGRICULTURE IN DENMARK

Agriculture in Denmark contributes an average of 1.2% to GDP and 2.1% to national employment.[32] The Danish agricultural sector is largely defined by animal husbandry or, more specifically, the pork industry. Of the average €10 billion per year produced by the Danish agricultural sector since 2010, nearly 40% comes from crop production.

What sets Denmark apart from other EU countries is the strict regulatory framework its crop production sector operates under. With the first pesticide action plan, introduced in 1986, the Danish government aimed to reduce pesticide usage as measured by the tonnes of active ingredients sold and a **Treatment Frequency Index (TFI).**[33] The government imposed a fee and a tax, which by 1998 was at 33% for herbicides, fungicides and growth regulators, and 54% for insecticides. The current approach, introduced in 2013, aims to reduce what is known as the pesticide load[34] and minimise overall usage. The tax level per pesticide is based on an assessment of the pesticide's impact on human health, the environment in general, and groundwater specifically. Put simply, the riskier the pesticide, the higher the tax level.[35]

Although only a rough indicator used by the EU's EEA, average pesticide sale per hectare of agricultural land in Denmark is lower than in most EU countries.[36] The stringent regulatory environment and general political and social narrative surrounding pesticide usage in Denmark is an important component of Danish crop cultivation. It is therefore important to take note of the regulatory environment the Danish farmer operates in when estimating what the effect of a restricted toolbox will be on farmers' yields and incomes.

The total average annual Danish crop production value since 2010 is approximately €3.6 billion. The crops covered in this study include five staple crops: wheat, sugar beet, potatoes, OSR and barley (spring and winter). There are also three other common crops: grass seeds,[37] rye, and maize for silage. This study covers almost two-thirds of total Danish crop production value (Exhibit 34).

DANISH FARM-LEVEL EFFECTS

The Danish farmer currently has 33 of the 75 at-risk substances in their toolbox. The availability of the 33 at-risk substances currently available in Denmark affects two key revenue and cost determinants: the yield and the production cost (Table 12).

Of the five staple crops, Danish potato farmers benefit the most from the currently available toolbox. Having a complete toolbox available

32 EUROSTAT (2018).

33 TFI is calculated as the number of pesticide applications on cultivated area per calendar year (Pedersen, 2016).

34 The current goal for the Pesticide Load Indicator (PLI) is set at 1.96.

35 ENDURE (2013).

36 Estimates for the period 2011 to 2016 based on EUROSTAT statistics are at around 1 kg per hectare in Denmark and 2 kg per hectare on average in the EU.

37 These include ryegrass, perennial ryegrass, Italian ryegrass, hybrid ryegrass, red fescue and meadow grass.

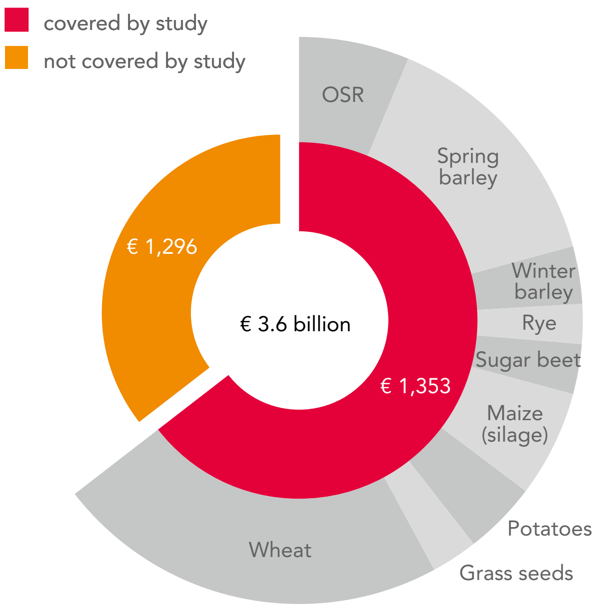


***Exhibit 20**: Danish agricultural production value (in € million)*

allows them to harvest approximately 16% more tonnes per hectare. The loss in yield faced by potato farmers is primarily driven by the low number of fungicides available to treat early and late blight. Starch potatoes in Denmark are sprayed 12–14 times per season. If fluazinam, difenoconazole and mandipropamid disappear, the remaining efficient alternatives for these substances, like cyazofamid, can only cover a part of the season. As a result, farmers would most likely have to desiccate the potatoes two to four weeks earlier, leading to a short-term yield loss between 10% and 15%, because of lack of efficient fungicides.

Danish maize farmers by comparison, face much lower yield losses without the availability of the 33 substances. While the loss of glyphosate will impact maize cultivation, it is expected that farmers will rely on mechanical ploughing for control of thistles and other perennial weeds. It is estimated that because of the already stringent regulations on pesticide usage and the high level of research into non-chemical alternatives, switching to mechanical weed control will have a relatively smaller impact on yields.

However, the loss of glyphosate from the Danish farmer's current toolbox is an important driver of cost changes. For cereals, the loss of glyphosate will lead to an increase in costs of at least €48 per ha. The higher costs are the result of farmers having to resort to non-chemical alternatives, such as mechanical weeding, to manage perennial weeds and the drying of grain.

***Table 8**: Short-term yield and variable cost changes* [36]

		Yield			Production Cost		
Crop	Ex-farm price (€/t)	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
SUGAR BEET	48	60.7	−15%	51.5	1,144	164	1,308
POTATOES	99	41.1	−16%	34.4	2,383	422	2,806
GRASS SEEDS	1,117	1.5	-5%	1.4	595	−8.7	586
OSR	383	3.8	−10%	3.4	740	83	822
WHEAT	175	7.2	−14%	6.2	564	17	581
WINTER BARLEY	169	6.1	−5%	5.8	508	68	576
SPRING BARLEY	176	5.5	−6%	5.2	464	68	532
RYE	161	5.9	−3%	5.7	486	52	537
MAIZE (SILAGE)	34	33.8	−1%	33.5	890	13	903

38 *This data is provided by the experts.*

Danish potato farmers also face notably higher costs, however this in large part driven by considerably more expensive chemical alternatives. It is estimated that alternatives currently available for the treatment of late blight will increase costs by €393 per ha. Grass seed farmers on the other hand, face a cost decrease. This is because while some alternative chemical treatments are more expensive, the farmer saves costs on seed treatment.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 2% reduction in yield for grass seeds and a 19% loss of production for OSR.

With the current toolbox at their disposal, Danish farmers are able to operate with a positive gross margin, ranging from an average 22% per hectare for maize (for silage) farmers to an average 64% for grass seed farmers (Exhibit 21).[39]

A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Danish farmer. Despite the loss of the 33 substances, all farmers will still be able to operate with a gross profit. Danish grass seed farmers face the smallest per hectare gross margin loss, from 64% to 62%, whereas potato farmers face the highest per hectare gross margin loss, from 41% to 18%. Or, in other words, a gross profit loss of 64% per hectare (Table 8).

A stable ex-farm price is assumed when analysing the yield and cost changes on farmer incomes. However, the loss of substances can also affect the quality of the harvested crop. A loss of quality can subsequently impact the ex-farm price. The loss of triazoles for spring barley means that the proportion of small grains will increase. These small grains are not suitable for malting; the experts estimate that approximately 5% of the malting barley area will receive a lower price. Similarly, the loss of triazoles will impact the oil yield of the OSR crop and reduce the baking quality of bread rye and wheat.

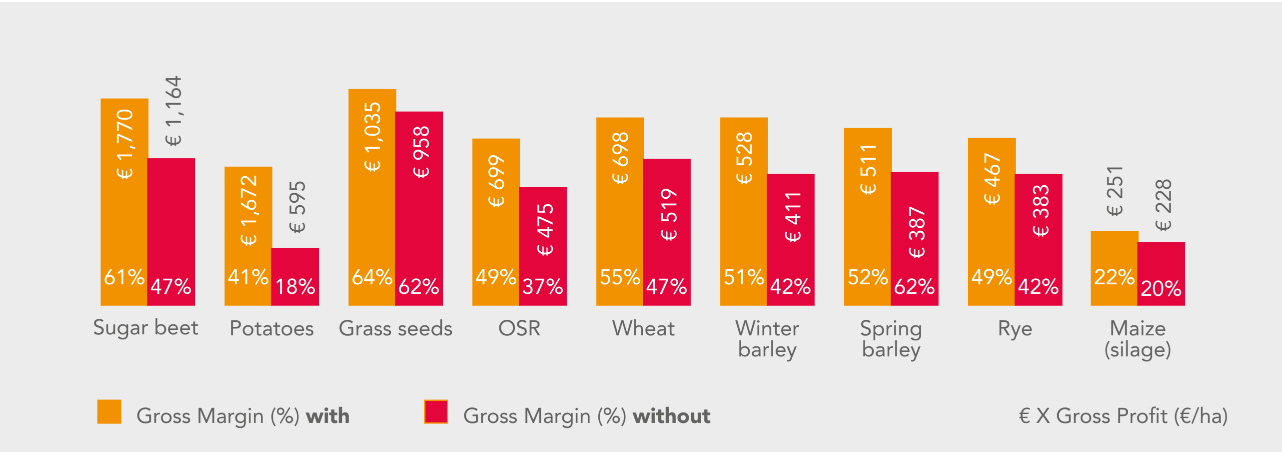


***Exhibit 21**: Income effects at farm level (in €/ha)*

39 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)–(costs)) / (revenue) = ((ex-farm price * yield)–(costs)) / (ex-farm price * yield).*

DANISH COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Danish farm level will translate into effects at the national level. Assuming a stable annual production area, Denmark stands to lose approximately 1.6 million tonnes of crop production with a restricted toolbox.[40]

Danish cereal producers stand to lose 912 million tonnes of their crop production with the restricted toolbox. This constitutes approximately 10% of total cereal production in Denmark (an average 9.3 million tonnes per year). More than half of the lost cereal production is driven by a 14% yield decrease in the production of Denmark's largest cereal crop, wheat.

The loss of 1.6 million tonnes of crop production annually is equal to a loss of €221 million in production value (Exhibit 22). The total loss of production value for cereal crops is approximately €151 million or 69% of total value loss. This is concomitant with the high loss in tonnes produced, with the highest loss in value (approximately half) resulting from the loss in wheat production.

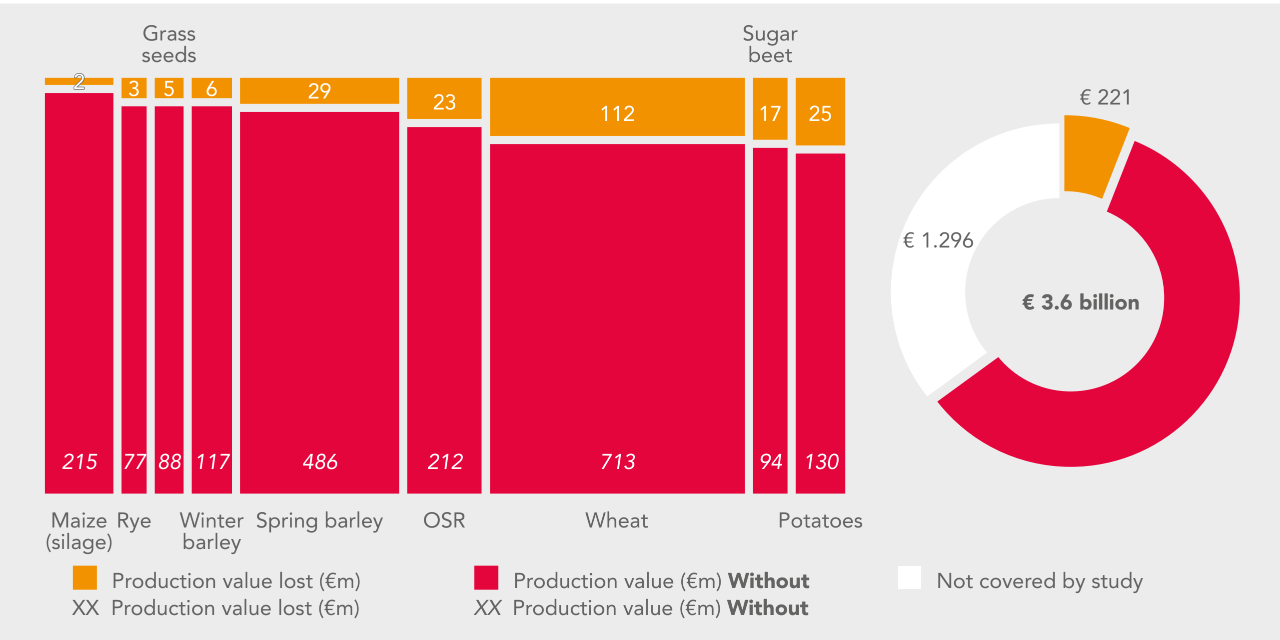


***Exhibit 22**: Total production value in scope (in € million), left; total production value (in € million), right*[39]

40 *For detailed crop production statistics, please refer to Annex 3.*

41 *Differences in totals are due to rounding.*


07

Finland

For four key staple crops, the currently available farming toolbox allows Finland to produce an additional 1,128,000t and generate an additional €188 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 275,000t of output and €106 million would be at stake. Further results include:

- In the short run for the crops in scope, Finnish farmers will lose on average 41% of their yield with a restricted toolbox;
- Variable production costs for the staple crops would increase by up to 19% per hectare;
- The average gross margin per hectare enjoyed by the Finnish farmer will drop to −12%.
- Finnish carrot farmers face the highest yield loss; without their current toolbox, they will lose 100% of their yield.
- Finnish crop agriculture provides approximately 35,000 direct jobs, of which 19,800 depend on the crops covered by the study.

AGRICULTURE IN FINLAND

Agriculture in Finland contributes on average 2.8% to GDP and 3.3% to national employment. The cultivation of crops in Finland, constituting approximately a third of Finland's total agricultural value, is defined by the weather. The majority of Finnish farms is above the 60th parallel and are challenged by severe winters and short and unpredictable growing seasons.

In 2017, Finland received €1,377 million in CAP payments, of which €552 million was in **less-favoured area** (LFA) payments. Because of the adverse climate conditions, the whole of Finland is entitled to LFA payments from the EU. The Finnish farmer is highly dependent on subsidies. For the EU programming period of 2014 to 2020, the average Finnish farm will receive €12,663 per year in EU support, which is equivalent to 143% of farm net value added. This is the highest in the EU; the average farm in Sweden receives 73% of farm net value added in EU support and, in the Netherlands, the farms receive an average 14%. In addition to the CAP support, approximately €330 million in national aid is paid to Finnish farmers.

Profitability of Finnish agriculture and horticulture has steadily decreased since the 2000s.[42] While the average farm size and total revenue have increased, costs are rising faster than revenues leading to declining profitability. For Finnish crop agriculture, high input prices and variations in ex-farm price and yields have affected farm economics greatly. This is especially the case for cereal farmers. Cereals are an important part of Finland's agricultural sector. Of the total utilised agricultural area in Finland—an average of 2.25 million hectares—approximately one million hectares are used to cultivate cereals. However, Finnish cereal farmers operate at a low gross margin rate and must contend with great variability in weather conditions (affecting yield) and high fluctuations in market prices. Between 2011 and 2015, the yield per hectare for spring barley fluctuated between 3.85 tonnes per hectare

42 *Luke, Natural Resources Institute Finland (2017). Finnish agriculture and food sector 2016/17.*

(in 2013) and 3.47 (in 2015), and the price per tonne fluctuated between €179 (in 2012) and €128 (in 2014). As a result of lower yields and lower producer prices, the average gross margin rate per hectare for spring barley farmers dropped to 12% (Exhibit 23).[43]

The total average annual Finnish crop production value since 2010 is approximately €1.4 billion. The crops covered in this study include four staple crops: wheat (winter and spring), barley (spring), potatoes and OSR; and five specialty crops: rye, oats, carrots, strawberries and caraway. This study covers a little over half of total Finnish crop production value (Exhibit 24).

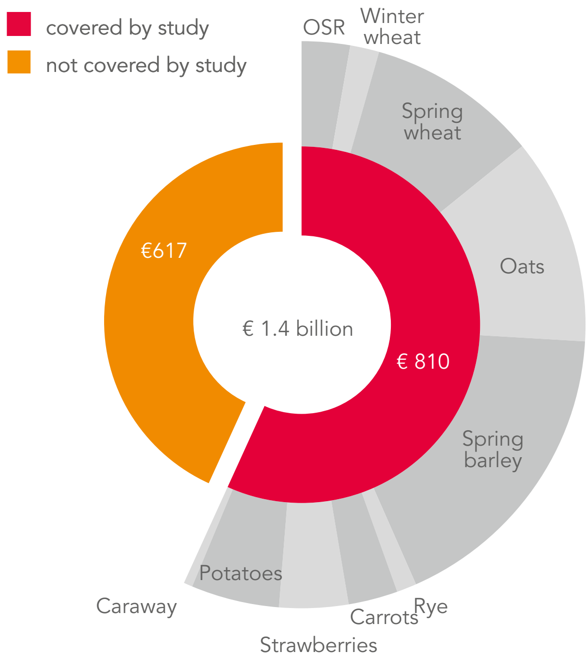


***Exhibit 24**: Finnish agricultural production value (in € million)*

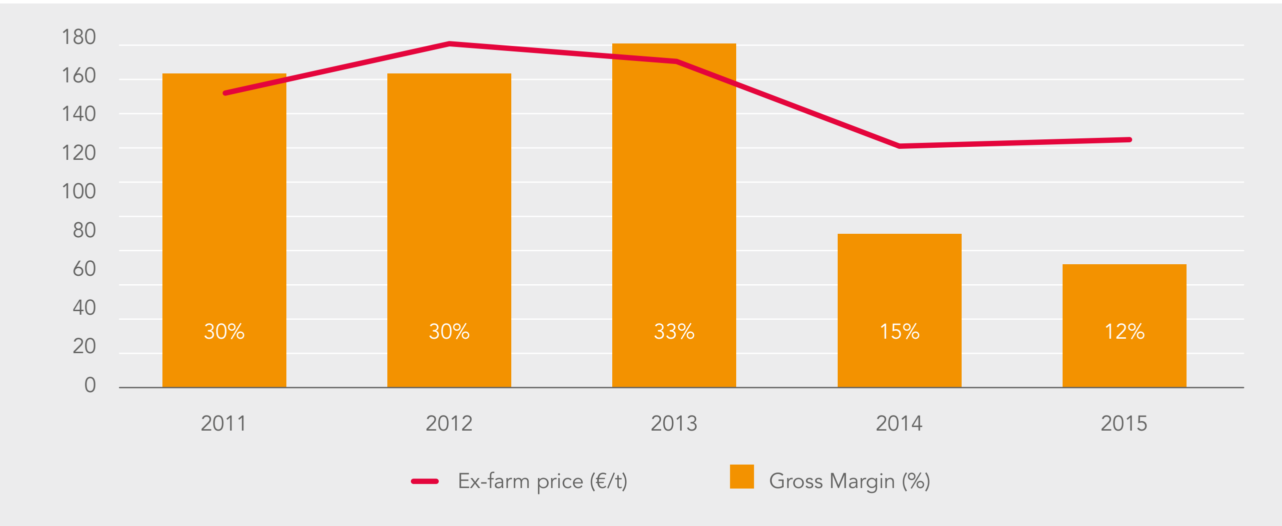


***Exhibit 23**: Spring barley gross margin and ex-farm price fluctuations*

43 *The gross margin rates are indicative and calculated based on revenue and variable cost figures. Subsidies and total costs are not taken into account.*

FINNISH FARM-LEVEL EFFECTS

Finnish farmers currently have 36 of the 75 at-risk substances in their toolbox. The availability of the 36 at-risk substances currently available in Finland affects two key revenue and cost determinants: yield and production cost (Table 9).

Of the four staple crops, Finnish OSR farmers benefit the most from the currently available toolbox. A complete toolbox allows them to harvest approximately 62% more tonnes per hectare. The greatest pest threat for OSR farmers in Finland is insects, specifically the flea and blossom beetles, which can destroy an OSR field in its entirety without the proper insecticides. The other staple crops enjoy 28%–45% higher yields with the current toolbox.

The only alternative available to the farmer to treat weeds following a loss of glyphosate from their toolbox would be mechanical tillage. In addition to the impact on the yield of all crops in scope, the increased usage of mechanical tillage will in turn increase nutrient leaching and eutrophication of surface waters.

Finnish farmers without the current toolbox at their disposal face increased production costs, ranging between €6 per hectare for OSR and €4,970 per hectare for strawberries. The cost changes are largely the result of more expensive production inputs and more expensive pest treatment methods. For example, for all cereal crops in scope, farmers are required to buy more expensive certified seeds to counteract the loss of fungicides from their toolbox. Strawberry farmers without the ten at-risk herbicides in their toolbox, face an almost €2,000 per hectare increase in cost due to the high cost of hand weeding compared to glyphosate.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 46% reduction in yield for oats and a 100% loss of production for spring barley, winter and spring wheat, potatoes, carrots and strawberries. Potatoes, for example, would only have two active ingredients in their toolbox to treat late blight. The limited treatment alternatives will lead to a high resistance risk, which will affect the yield in the long term.

***Table 9**: Short-term yield and variable cost changes* [42]

Crop	Ex-farm price (€/t)	Yield			Production Cost		
		Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
CARROTS	627	42.1	−−100%	-	13,943	2,132	16,075
STRAWBERRIES	4,236	3.5	−53%	1.7	5,656	4,970	10,626
POTATOES	124	26.4	−45%	14.6	511	25	536
WINTER WHEAT	177	4.2	−28%	3.0	413	43	456
SPRING WHEAT	177	3.8	−28%	2.7	413	61	474
CARAWAY	700	0.6	−30%	0.4	289	59	348
SPRING BARLEY	156	3.6	−34%	2.4	413	60	473
OATS	163	3.4	−18%	2.8	413	52	465
OSR	409	1.3	−62%	0.5	413	6	419
RYE	166	3.1	−17%	2.6	413	19	432

44 *This data is provided by the experts.*

Finnish farmers with the current toolbox are all able to operate with a positive gross margin, ranging from an average 21% per hectare for rye farmers to an average 84% for potato farmers (Exhibit 25).[45] A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Finnish farmer. Excluding potato, rye, and winter and spring wheat farmers, the loss of the availability of the 36 substances will result in a negative gross margin for the Finnish farmers in scope. The OSR, spring barley, strawberry and caraway farmers will face a gross margin loss of over 100%.

The gross margin losses resulting from a restricted toolbox should be viewed in the Finnish context of high subsidies and high climate pressures. While the Finnish rye and wheat farmers are still able to operate with a positive gross margin without the 36 substances, any fluctuations in yield due to climate pressures or changes in price can mean a negative gross margin. In the long run, negative gross margins will impact the economic viability of cultivating the ten crops in scope. Particularly for less competitive farms, a low or negative gross margin ratio will place additional pressure on EU subsidies and national aid.

FINLAND COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Finnish farm level will affect the national level. Assuming a stable annual production area, Finland stands to lose approximately 1.4 million tonnes of crop production annually with a restricted toolbox.[46]

Finnish cereal producers stand to lose one million tonnes of their crop production with the restricted toolbox. This constitutes almost a third of total cereal production in Finland (an average 3.5 million tonnes per year). More than half of the lost cereal production is driven by a 34% yield decrease in the production of Finland's largest cereal crop, spring barley, whereas carrot production in Finland, relative to total production in scope, is small. The Finnish agricultural sector could suffer the loss of 68,000 tonnes of carrots, due to the 100% loss in yield.

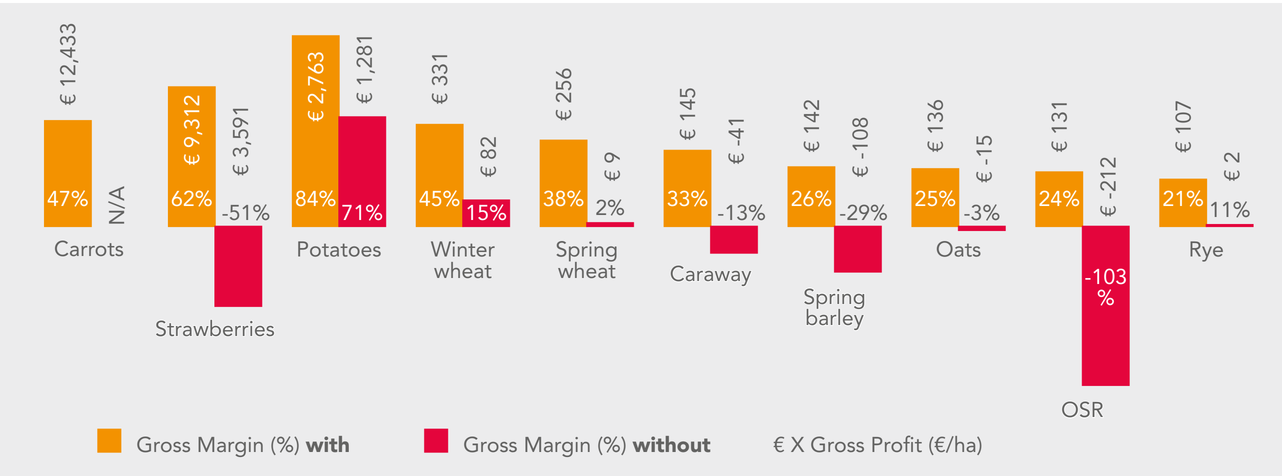


***Exhibit 25**: Income effects at farm level (in €/ha)*

45 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)–(costs)) / (revenue) = ((ex-farm price * yield)–(costs)) / (ex-farm price * yield).*

46 *For detailed crop production statistics, please refer to Annex 3.*

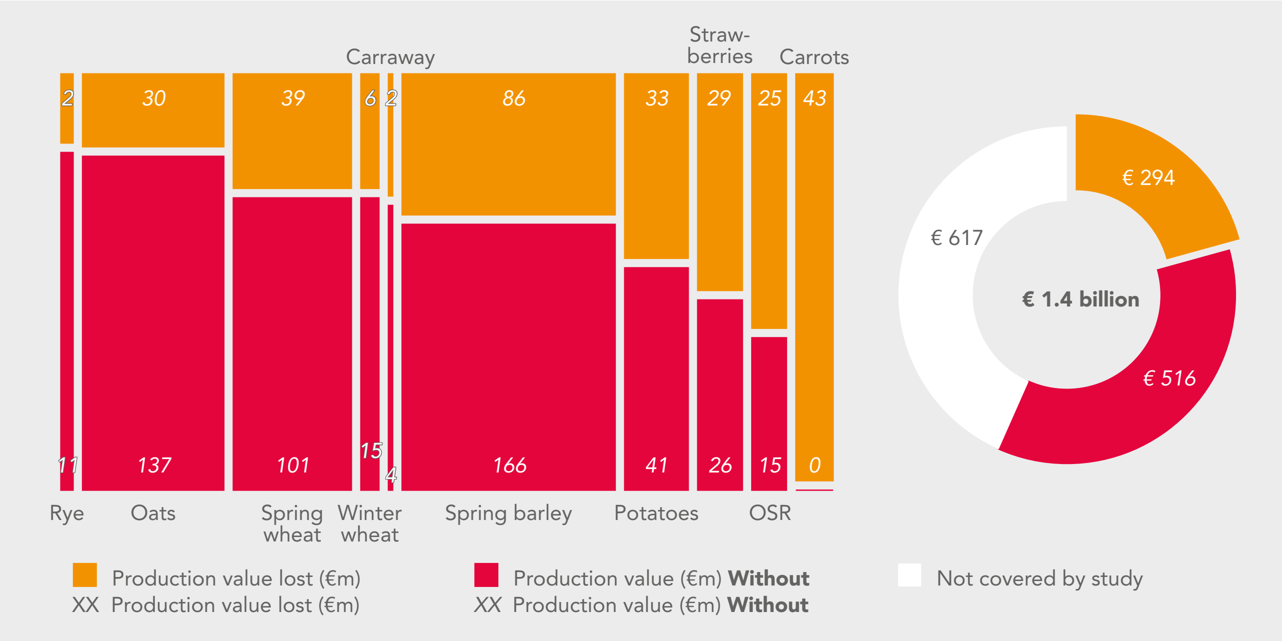


***Exhibit 26**: Total production value in scope (in € million), left; total production value (in € million), right* [45]

The loss of 1.4 million tonnes of crop production annually is equal to a loss of €294 million in production value (Exhibit 4). The total loss of production value for cereal crops is approximately €160 million or 55% of total value loss. This is concomitant with the high loss in tonnes produced. However, approximately a quarter of the value lost is due to the production losses of two high value crops: strawberries (€29 million) and carrots (€43 million).

It should be noted that the losses in production value assume a stable ex-farm price, which does not take quality into account. Particularly for the cereal crops, the restricted toolbox will lead to a decline in quality due to mycotoxins. Using oats as an example, the loss of fungicides will lead to poorer quality, a loss of approximately €30 per tonne, which is equivalent to a 20% drop in price.

47 Differences in totals are due to rounding.


8

Greece

For two important Greek export crops, cotton and olives for oil, the currently available farming toolbox allows Greece to produce an additional 1,258,000t and generate an additional €682 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of other fruit and vegetable crops: 1,443,000t of output and €1,602 million would be at stake. Further results include:

- In the short run for the crops in scope, Greek farmers will lose on average 41% of their yield with a restricted toolbox;
- Variable production costs for the staple crops would increase by up to 64% per hectare;
- The average gross margin per hectare enjoyed by the farmer will drop to −92%.
- Greek apple and pear farmers face the highest yield loss; without the current toolbox, they will lose 65% of their yield.
- Greek crop agriculture provides approximately 324,600 direct jobs, of which 236,000 depend on the crops covered by the study.

AGRICULTURE IN GREECE

Agriculture in Greece contributes on average 4.3% to GDP and 11.7% to national employment. The agricultural sector is characterised by small-scale structures which face considerable challenges. According to the European Commission, 78% of the total utilised agricultural area in Greece is classified as facing natural constraints; over three-quarters of agricultural holdings in Greece are smaller than five hectares; and more than half of Greek farmers are older than 55 years.

The total average annual Greek crop production value since 2010 has been approximately €6.5 billion. The crops covered in this study include 13 specialty crops: citrus fruits, olives (for oil), cotton, tomatoes cultivated under plastic, field-cultivated tomatoes, pears, peaches, cucumbers, onions, apples, as well as wine, table and raisin grapes. This study covers almost three-quarters of Greek crop production value (Exhibit 27).

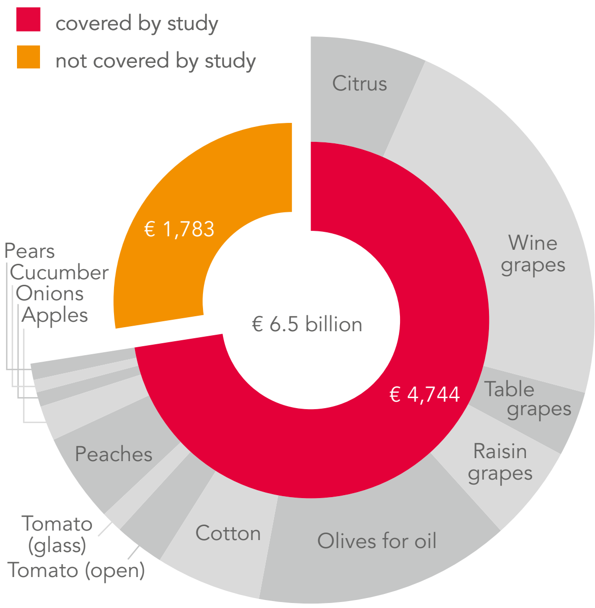


***Exhibit 27**: Greek agricultural production value (in € million)*

GREEK FARM-LEVEL EFFECTS

Greek farmers currently have 55 of the 75 at-risk substances in their toolbox. The availability of the 55 at-risk substances affects two key revenue and cost determinants: the yield and the production cost (Table 10).

A major threat to Greek fruit, vegetable and cotton production is insects. According to the Greek experts consulted, prior to 2010, pressure on cotton crops from insects in Greece was lower than it has been in recent years. The experts estimate that insect populations affecting cotton crops have almost tripled. A restricted farmer toolbox will largely affect the Greek farmer's ability to effectively deal with insects. While alternative insecticides are available, experts estimate that yield losses will range between −5% for citrus fruits and −50% for olives for oil. Greek apple and pear farmers benefit the most from the currently available toolbox. Having a complete toolbox available allows them to harvest approximately 65% more tonnes of fruit per hectare.

Greek farmers without the current toolbox at their disposal face increased production costs, ranging between €230 per hectare for olives and €2,200 per hectare for cotton. The cost changes are in part driven by the loss of herbicides. Farmers often resort to mechanical weeding to treat weeds, which can result in an additional cost of up to €2,000 per hectare for cotton.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 19% reduction in yield for citrus fruits and grapes, and a 61% loss of production for onions.

Greek fruit farmers with the current toolbox at their disposal are all able to operate with a positive gross margin, ranging from an average 17% per hectare for apple farmers to an average 99% per hectare for wine grape farmers (Exhibit 28).[49] A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Greek farmer. Given the wide range in current gross margin and estimated

***Table 10**: Short-term yield and variable cost changes[46]*

		Yield			Production Cost		
Crop	Ex-farm price (€/t)	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
FRUIT							
WINE GRAPES	2,530	9.2	−27%	6.7	222	500	722
TABLE GRAPES	900	16.8	−27%	12.3	300	500	800
RAISIN GRAPES	1,400	6.6	−27%	4.8	250	500	750
CITRUS FRUITS	400	22.4	−25%	16.8	1,000	250	1,250
PEARS	1,023	14.1	−65%	4.9	6,960	445	7,405
PEACHES	539	16.9	−35%	11	5,840	275	6,115
APPLES	466	21.6	−65%	7.6	8,360	375	8,735
VEGETABLES AND COTTON							
TOMATO (GLASS)	600	116.5	−43%	66	50,000	300	50,300
ONIONS	264	34	−49%	17.3	3,143	471	3,614
COTTON	420	3.3	−43%	1.9	1,300	2,200	3,500
OLIVES FOR OIL	600	1.5	−53%	0.7	1,980	230	2,210
TOMATO (OPEN)	250	32.4	−43%	18.4	13,000	300	13,300
CUCUMBER	300	70.6	−45%	38.8	55,000	300	55,300

48 *This data is provided by the experts.*

49 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)−(costs)) / (revenue) = ((ex-farm price * yield)−(costs)) / (ex-farm price * yield)*

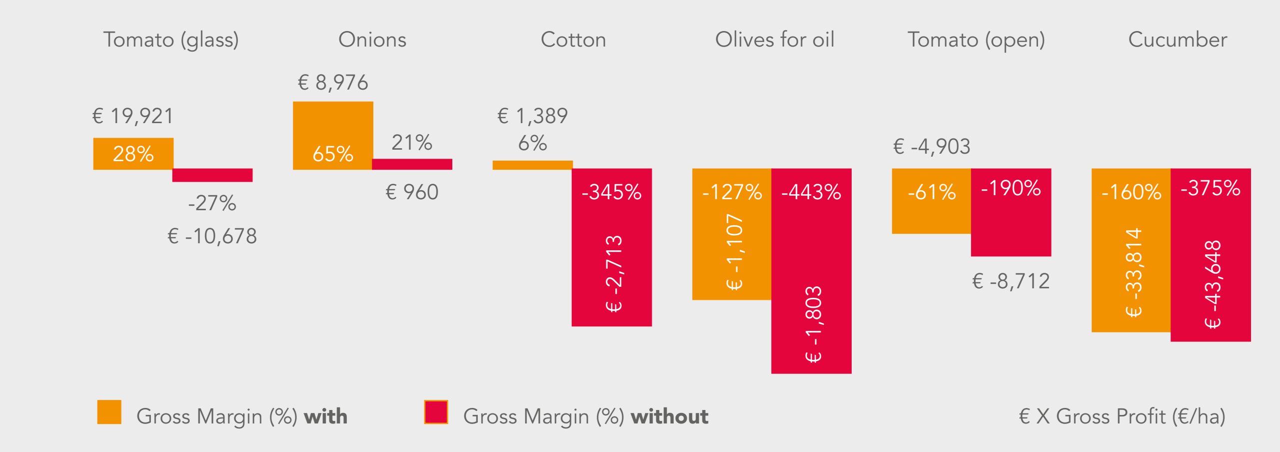


***Exhibit 28**: Income effects at fruit farm level (in €/ha)*

yield and cost changes per fruit, the loss of the availability of the 55 substances will affect Greek fruit producers very differently. Greek grape and citrus fruit farmers face low per hectare gross margin changes. Average gross margin without the 55 substances for grape farmers remains high at 92%. Greek pear, peach and apple farmers, on the other hand, face a negative gross margin with a restricted toolbox. Greek apple farmers, already operating at a low gross margin (17%), will be unable to cope with the estimated high yield loss (–65%) and cost increase. Without the 55 substances at their disposal, apple farmers will operate at a loss of approximately - €5,126 per hectare.

With the current toolbox, Greek vegetable and cotton farmers, excluding onion, greenhouse tomato and cotton producers, struggle to maintain a positive gross margin (Exhibit 29). Greek olive farmers, similar to those in Spain and Italy, are facing low incomes. According to the European Commission, the low Greek farming income is linked to the small farm size, high share of family labour, in addition to low labour and crop productivity.[50] Of the total €2 billion of direct payments made in 2017 under the CAP scheme, 15% went to Greek olive farmers. The loss of the 55 substances will put further stress on Greek olive farmer incomes and thus on olives for oil cultivation. Similar to olive farmers, the loss of the 55 substances will also decrease revenues for the other crops in this study, resulting in a negative per hectare gross margin for all of them, with the exception of onions.

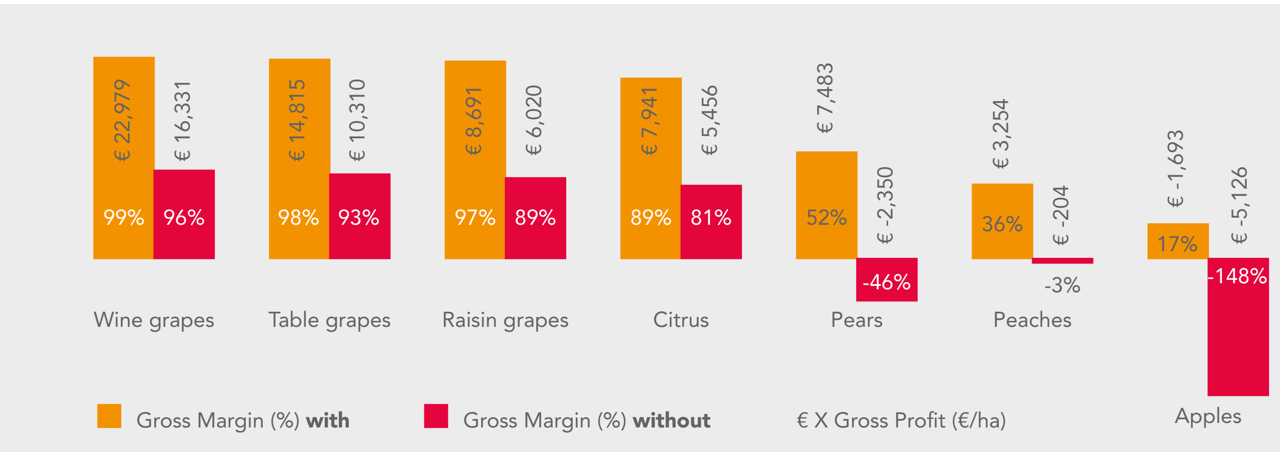


***Exhibit 29**: Income effects at vegetable and cotton farm level (in €/ha)*

50 *European Commission (2012) EU olive farms report.*

GREEK COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Greek farm level will translate into effects at the national level. Assuming a stable annual production area, Greece stands to lose approximately 2.7 million tonnes of crop production annually with a restricted toolbox.[51]

Greek fruit producers could lose one million tonnes of their crop production with the restricted toolbox. This constitutes over a quarter of total fruit production in Greece (an average 3.7 million tonnes per year). More than one quarter of the lost fruit production is driven by a 25% yield decrease in the production of citrus fruits. Greek olive producers stand to lose more than half of their crop: approximately 850,000 tonnes of olives. The olives for oil produced in Greece constitute between 10% and 20% of total annual EU production; losing approximately half of Greek production thus means a loss between 5% and 10% of EU olives for oil production.

The loss of 2.7 million tonnes of crop production annually is equal to a loss of €1,744 million in production value (Exhibit 30). The total loss of production value for fruit crops is approximately €899 million, or 54% of total value loss. This is concomitant with the high loss in tonnes produced. However, approximately two-thirds of the value lost is due to the production losses of two high-value crops: grapes (€543 million) and olives for oil (€512 million).

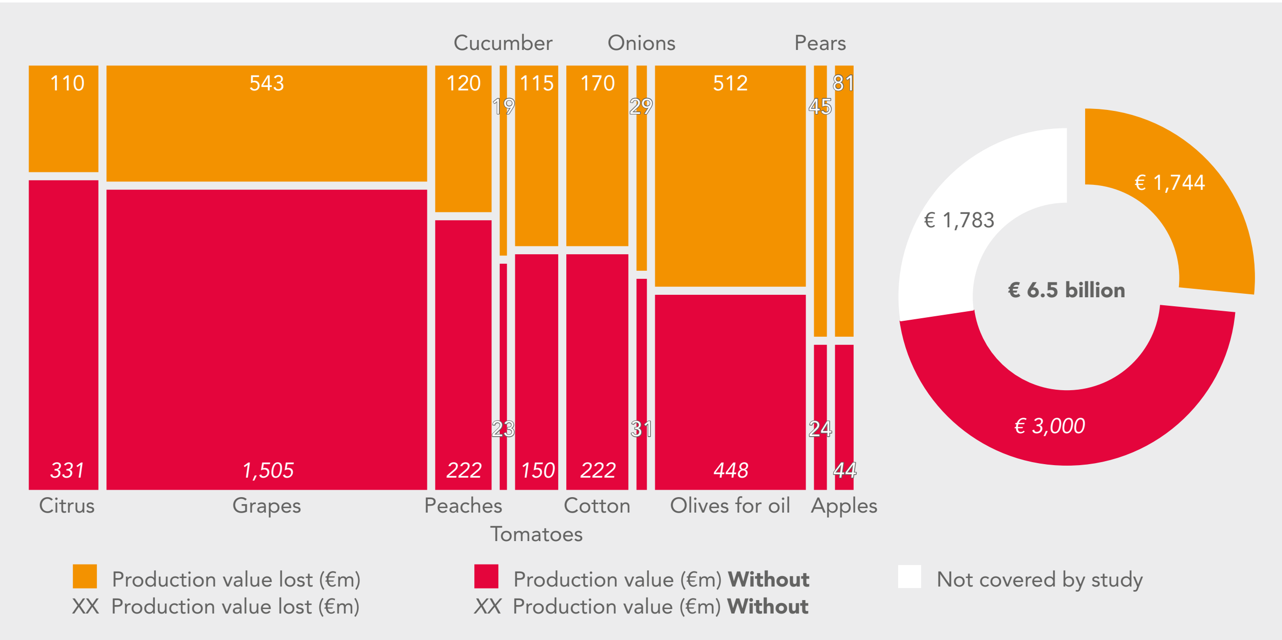


***Exhibit 30**: Total production value in scope (in € million), left; total production value (in € million), right*[50]

51 *For detailed crop production statistics, please refer to Annex 3.*

52 *Differences in totals are due to rounding.*

Hungary

For four key staple crops, the currently available farming toolbox allows Hungary to produce an additional 2,010,000t and generate an additional €340 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 136,000t of output and €101 million would be at stake. Further results include:

- In the short run for the crops in scope, Hungarian farmers will lose an average of 32% of their yield with a restricted toolbox;
- Variable production costs for the crops would increase by up to over 100% per hectare;
- The average gross margin per hectare enjoyed by the Hungarian farmer will drop to −64%.
- Hungarian crop agriculture provides approximately 159,000 direct jobs, of which 82,100 depend on the crops covered by the study.

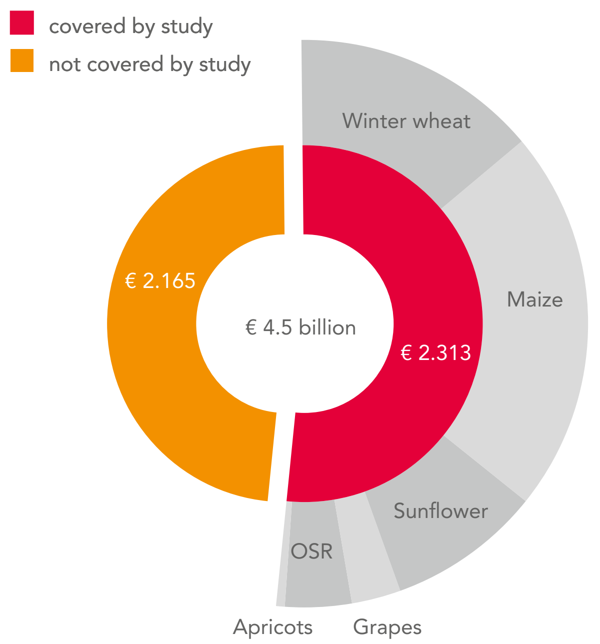


***Exhibit 31**: Hungarian agricultural production value (in € million)*

AGRICULTURE IN HUNGARY

Agriculture in Hungary contributes on average 4.3% to GDP and 4.8% to national employment.[53] Of the approximately half-million farms in Hungary, 85% are smaller than five hectares. While 81% of agricultural land is used for arable farming, crop production constitutes only an average of 61% of annual agricultural value in Hungary. In the past decade, however, Hungarian farms have not only expanded in terms size, but also economically, with an increase of more than 30% over the 2007–2013 timeframe.[54]

The total average annual Hungarian agricultural production value since 2010 has been approximately €4.5 billion. The crops covered in this study include four staple crops, winter wheat, maize, grapes and OSR; and two specialty crops, sunflower and apricots. This study covers over half of the total Hungarian crop production value (Exhibit 31).

53 *EUROSTAT (2018).*

54 *As measured by standard output per farm. The standard output, as per the EUROSTAT definition, is the average monetary value of the agricultural output at farm-gate price, in €per hectare or per head of livestock.*

HUNGARIAN FARM-LEVEL EFFECTS

Hungarian farmers currently have 57 of the 75 at-risk substances in their toolbox. The current availability of the 57 at-risk substances in Hungary affects two key revenue and cost determinants: the yield and the production cost (Table 11).

Of the four staple crops, Hungarian grape farmers benefit the most from the currently available toolbox. Having a complete toolbox available allows them to harvest approximately 66% more tonnes per hectare. The greatest pest threat to grape farmers in Hungary are fungi, with fungicides being used to predominantly treat mildew and black rot. The other staple crops enjoy 2–36% higher yields with the current toolbox. According to the experts, apricot cultivation in Hungary is very susceptible to pests, and is particularly susceptible to infections from the fungus **Monilinia**, which can lead to yield losses of up to 30%.

In addition declining yields, Hungarian farmers without the current toolbox at their disposal face increased production costs, ranging between €19 per hectare for maize and €2,983 per hectare for apricots. For apricot farmers, a tree infected by the fungus **Monilinia** means that the farmer must buy a new tree. It is estimated that this will lead to an increase of €1,290 per hectare for 80% of land cultivated for apricot production.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 14% reduction in yield for maize and sunflower, and a 58% loss of production for grapes.

Hungarian farmers with the current toolbox at their disposal are able to operate with a positive gross margin, ranging from an average 29% per hectare for grape farmers to an average 91% for apricots (Exhibit 32).[56] A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Hungarian farmer. Excluding maize, sunflower and OSR farmers, the loss of the availability of the 57 substances will result in a negative gross margin for the Hungarian farmers in scope.

55 *This data is provided by the experts.*

56 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)–(costs)) / (revenue) = ((ex-farm price * yield)–(costs)) / (ex-farm price * yield).*

***Table 11**: Short-term yield and variable cost changes*[53]

Crop	Ex-farm price (€/t)	Yield: Yield WITH (t/ha)	Yield: Yield Change (Δ %)	Yield: Yield WITHOUT (t/ha)	Production Cost: Cost WITH (€/ha)	Production Cost: Cost Change (Δ €/ha)	Production Cost: Cost WITHOUT (€/ha)
APRICOTS	717	6.2	−69%	1.9	412	2,983	3,395
GRAPES	284	6.0	−66%	2.0	1,214	1,125	2,339
MAIZE	142	5.7	−2%	5.6	437	19	456
SUNFLOWER	316	2.3	−9%	2.1	364	57	421
OSR	336	2.3	−8%	2.1	442	51	493
WINTER WHEAT	146	4.0	−36%	2.6	337	209	546

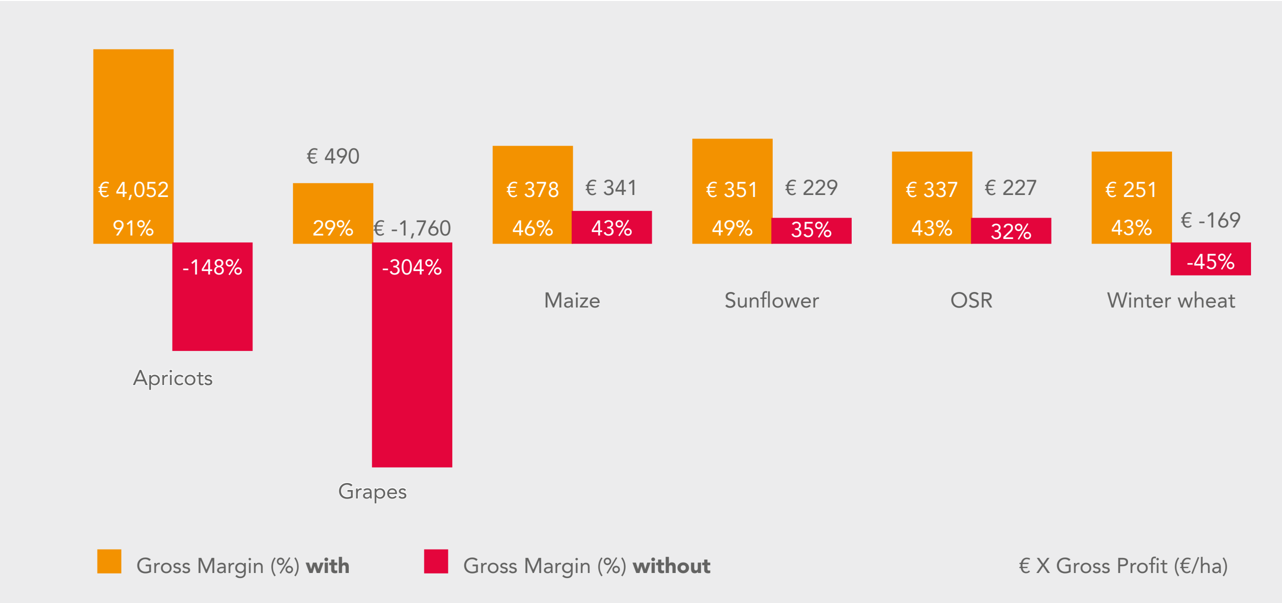


***Exhibit 32**: Income effects at farm level (in €/ha)*

HUNGARIAN COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Hungarian farm level will impact the national level. Assuming a stable annual production area, Hungary stands to lose approximately 2.1 million tonnes of crop production annually with a restricted toolbox.[57]

The greatest loss for the crops in scope, in terms of tonnes, will be due to the 36% loss in winter wheat production. The 1.5 million tonnes of winter wheat production lost will constitute approximately 10% of total annual cereal production in Hungary. In addition to a high loss to cereal production, Hungary also faces a loss of approximately two-thirds, or 150,000 tonnes, of total grape production. In Hungary, grapes are primarily cultivated for local consumption, estimated at 90% of local production, with the bulk of Hungarian grapes used in the local wine industry. Losses in output will not only affect Hungarian grape farmers, but may also have a further knock-on effect in the production of Hungarian wine.

57 For detailed crop production statistics, please refer to Annex 3.

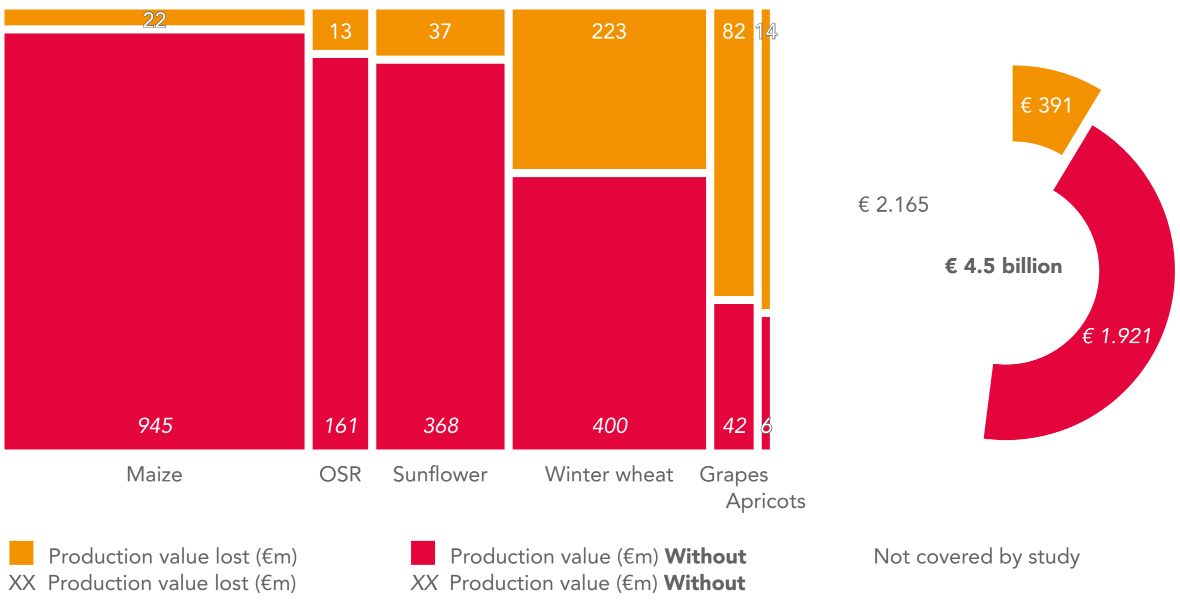
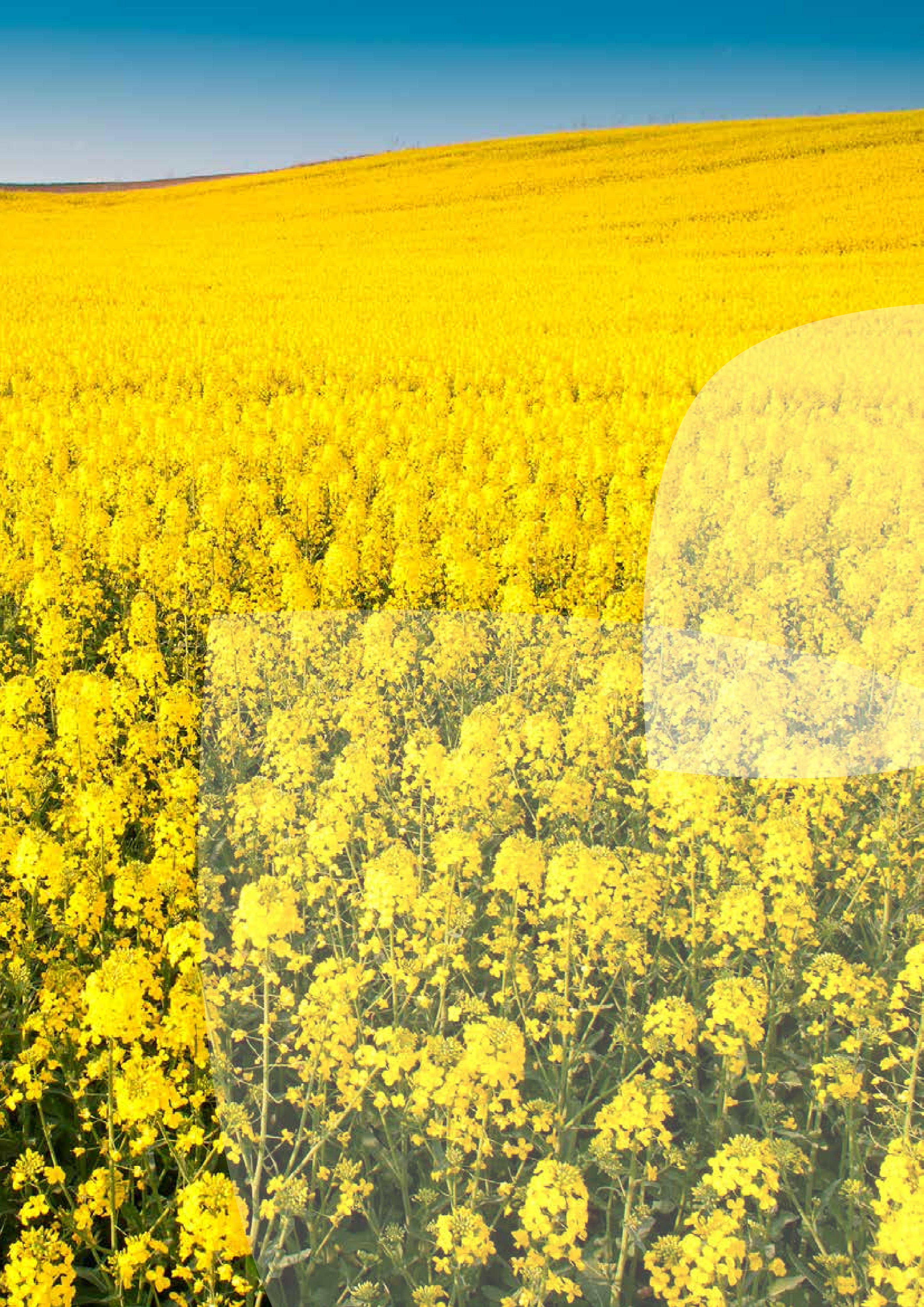


***Exhibit 33**: Total production value in scope (in € million), left; total production value (in € million), right*[56]

The loss of 2.1 million tonnes of crop production annually is equal to a loss of €391 million in production value (Exhibit 22). The total loss of production value for winter wheat is approximately €223 million or 57% of total value loss. Apricots constitute only 1% of total Hungarian crop value; however, it is important to note that experts estimate a restricted toolbox will make apricot cultivation unattractive for Hungarian farmers. Although apricot farmers currently enjoy a high gross margin, the crop is very susceptible to pests and changes in weather patterns (e.g. spring frost). A restricted toolbox likely means more volatility and income insecurity, potentially leading to Hungarian apricot farmers ceasing production altogether.

58 *Differences in totals are due to rounding.*




10

Romania

For five key staple crops, the currently available farming toolbox allows Romania to produce an additional 8,465,000t and generate an additional €1,437 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 392,000t of output and €101 million would be at stake. Further impacts include:

- In the short run for the crops in scope, Romanian farmers will lose on average 37% of their yield with a restricted toolbox;
- Variable production costs for the crops would increase by up to 13% per hectare;
- The average gross margin per hectare enjoyed by the Romanian farmer will drop to −101%.
- Romanian crop agriculture provides approximately 1,886,000 direct jobs, of which 736,700 depend on the crops covered by the study.

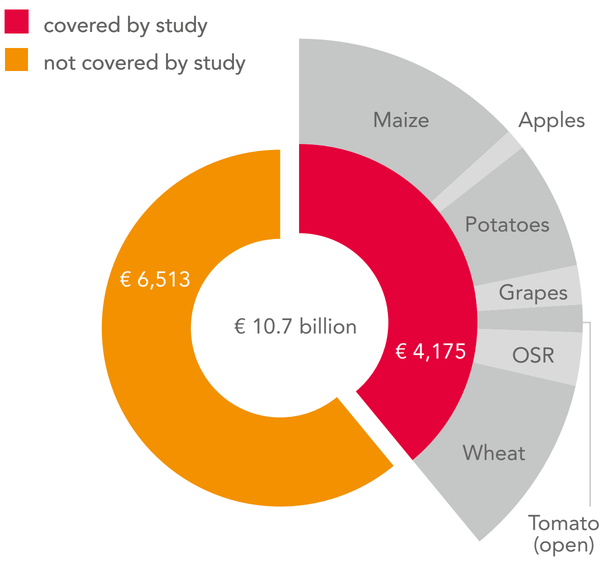


***Exhibit 34**: Romanian agricultural production value (in € million)*

AGRICULTURE IN ROMANIA

Agriculture in Romania contributes on average 4.8% to GDP and 19.8% to national employment.[59] Approximately 50% of Romanian land is used for agriculture, and almost half of the population lives in rural areas.

Of the total annual agricultural output value of €14.7 billion, almost three-quarters is from agricultural crop production. In Romania, 92.2% of the holdings are less than 5 ha, and most farms are small subsistence or semi-subsistence farms. To illustrate, the average farm in Romania generated approximately €3,300 of output per year, whereas the average farm in the Netherlands generated approximately €303,800 per year (a factor of 92). However, in the fertile southern region of Romania, farms are increasingly consolidating into very large farms, particularly for cereal cultivation.

The total average annual Romanian crop production value since 2010 has been approximately €10.7 billion. The crops covered in this study include five staple crops: wheat, maize, potatoes, OSR and grapes. There are also two specialty crops: apples and open tomatoes. This study covers a little over one-third of total Romanian crop production value (Exhibit 34).

ROMANIAN FARM-LEVEL EFFECTS

Romanian farmers are currently using 55 of the 75 at-risk substances. The 55 at-risk substances presently available in Romania affect two key revenue and cost determinants: the yield and the production cost (Table 12).

Of the five staple crops, Romanian maize farmers benefit the most from the currently available toolbox. Having a complete toolbox available allows them to harvest approximately 51% more tonnes per hectare. The greatest pest threat to maize farmers in Romania are insects; this is

59 EUROSTAT (2018).

***Table 12**: Short-term yield and variable cost changes*[58]

Crop	Ex-farm price (€/t)	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
		Yield			Production Cost		
TOMATO (OPEN)	275	17.5	−20%	14.0	2,500	400	2,900
POTATOES	255	14.5	−18%	11.9	2,100	250	2,350
OSR	334	2.3	−30%	1.6	450	12	462
MAIZE	145	3.9	−51%	1.9	365	30	395
WHEAT	166	3.4	−33%	2.3	388	79	467
GRAPES	285	4.6	−46%	2.5	1,200	300	1,500
APPLES	220	9.0	−59%	3.7	5,544	206	5,750

particularly an issue in the south of Romania where farmers are heavily reliant on neonicotinoids. The other staple crops enjoy 18–46% higher yields with the current toolbox.

Romanian farmers without the current toolbox at their disposal face increased production costs, ranging between €12 per hectare for OSR and €300 per hectare for grapes. For grape farmers with access to the full toolbox, there will be higher efficacy and therefore lower treatment frequency. A restricted toolbox will increase the number of treatments and therefore the costs.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. The long-term resistance effects on crop yields can vary between a 10% reduction in yield for grapes and tomatoes and a 73% loss of production for maize.

Romanian farmers (not including apple farmers) with the current toolbox are able to operate with a positive gross margin, ranging from an average

60 *This data is provided by the experts.*

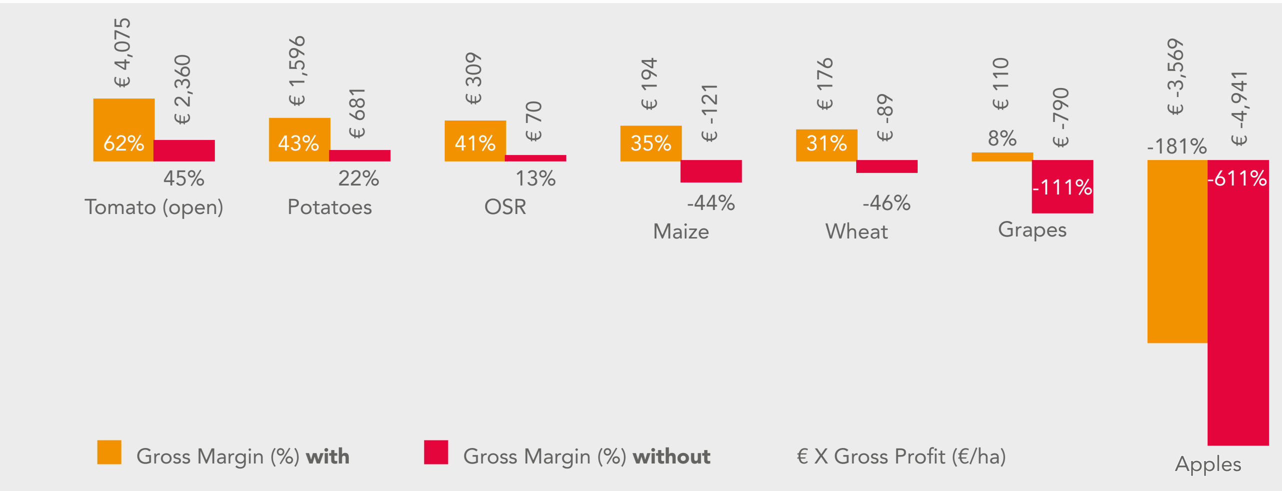


***Exhibit 35**: Income effects at farm level (in €/ha)*

Table 13: *Short-term yield and variable cost changes per maize farm type*

Crop	Yield			Production Cost		
	Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
LARGE CONSOLIDATED FARMS	6.5	−60%	2.6	580	30	610
SUBSISTENCE FARMS	3.0	−40%	1.8	180	16	196

8% per hectare for grape farmers to 62% for open-field tomato farmers (Exhibit 35).[61] Apple farms in Romania are generally small; smallholder farmers tend to own fields less than 2 ha and receive approximately €0.10 per kilo. Given the lack of profitability of apple cultivation, the EU has encouraged apple farmers to rotate seed fruits with stone fruits. This has allowed Romania to continue to cultivate apples, albeit on a much smaller scale.

A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the Romanian farmer. Excluding OSR, open-field tomato, and potato farmers, the loss of the 55 substances will result in a negative gross margin for the Romanian farmers in scope. The wheat, maize and grape farmers will face a gross margin loss of over 100%.

Similar to many other crops cultivated in Romania, the farm structures of maize holdings vary from large consolidated farms to small subsistence farmers. The large consolidated maize farms are primarily situated in the south of Romania, cultivating on a little less than half of the maize production area. However, the yields enjoyed by these larger farms are much higher, and they subsequently contribute over two-thirds of total national maize production. It should be noted that Romania is one of the EU's largest maize producers and exporters, the bulk of which is sourced from the large farms.

The farmer toolbox used for maize cultivation differs per farm type. Because large consolidated farms are much more industrialised, crop protection use is more intensive. Small subsistence farmers, however, already begin with a a much more limited toolbox. The loss of the 55 substances will therefore impact the yield and production cost of the farm types differently (Table 13), the large consolidated farms facing higher yield losses and higher production cost increases.

These yield and cost changes greatly influence the farm level. With the current toolbox at their disposal, both types of maize farmers are able to operate with a positive gross margin. However, the loss of the 55 substances will lead to a gross margin loss of over 100% for the large consolidated maize farmers (Exhibit 36).

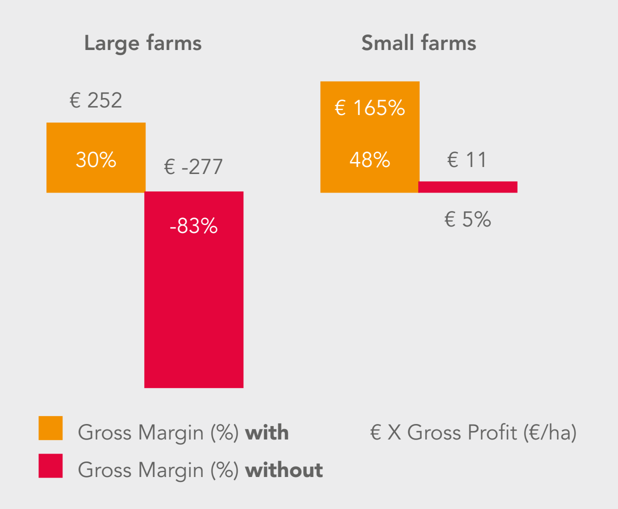


Exhibit 36: *Income effects at farm level per maize farm type (in €/ha)*

61 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)−(costs)) / (revenue) = ((ex-farm price * yield)−(costs)) / (ex-farm price * yield)*

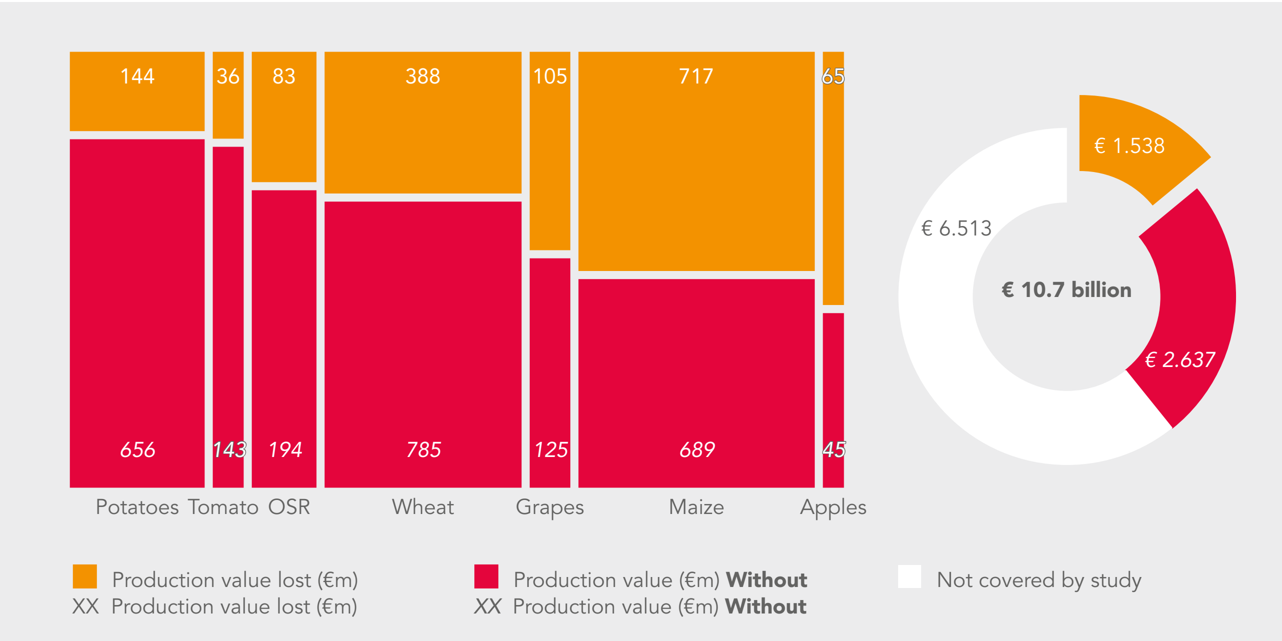


***Exhibit 37**: Total production value in scope (in € million), left; total production value (in € million), right* [61]

ROMANIAN COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Romanian farm level will impact the national level. Assuming a stable annual production area, Romania stands to lose approximately 8.9 million tonnes of crop production with a restricted toolbox.[62]

Romanian cereal producers stand to lose 7.3 million tonnes of their crop production with the restricted toolbox. This constitutes over one-third of total cereal production in Romania (an average 18.9 million tonnes per year). More than half of the lost cereal production would be driven by a 51% yield decrease in the production of Romania's largest cereal crop, maize.

The loss of 8.9 million tonnes of crop production annually is equal to a loss of €1,538 million in production value (Exhibit 37). The total loss of production value for cereal crops is approximately €1,105 million or 72% of total value loss. This is concomitant with the high loss in tonnes produced, with the highest loss in value (almost 50%) resulting from the blow to maize production.

62 *For detailed crop production statistics, please refer to Annex 3.*

63 *Differences in totals are due to rounding.*

Sweden

For five staple crops, the currently available farming toolbox allows Sweden to produce an additional 815,000t and generate an additional €133 million value per year than if the 75 at-risk substances were not included. A restricted toolbox will also affect the economic viability of specialty crops: 102,000t of output and €37 million would be at stake. Further results include:

- In the short run for the crops in scope, Swedish farmers will lose on average 23% of their yield with a restricted toolbox;
- Variable production costs for the crops would increase by up to 14% per hectare;
- The average gross margin per hectare enjoyed by the Swedish farmer will drop to −25%.
- Swedish crop agriculture provides approximately 29,400 direct jobs, of which 12,200 depend on the crops covered by the study.

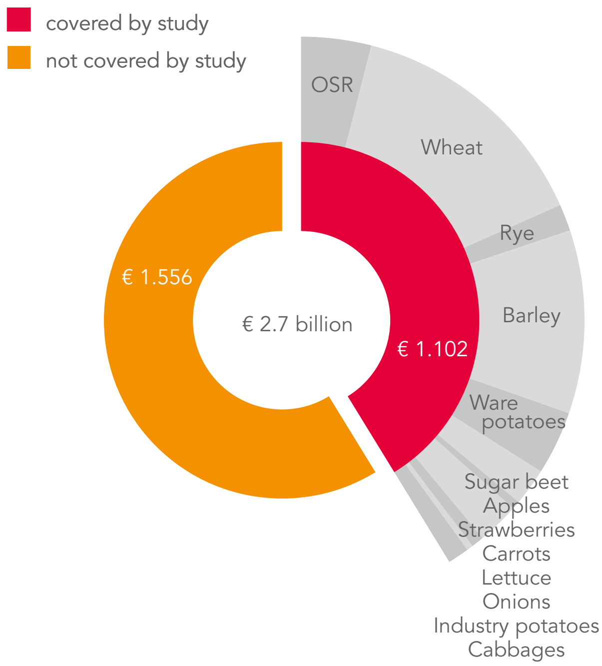


***Exhibit 38**: Swedish agricultural production value (in € million)*

AGRICULTURE IN SWEDEN

Agriculture in Sweden contributes an average 1.2% to GDP and 1.5% to national employment.[64] Structural changes in agriculture over the past 50 years have resulted in a sharp decline in the number of farms in Sweden. Most farms are family businesses, with family members combining farming with other activities for income.

Sweden has traditionally been self-sufficient in basic foods including meat, dairy products and cereals. However, over the last two decades, imports have shown a steady yearly increase. The total degree of self-sufficiency is at present estimated at 45–50%, which means that 50–55% is imported.[65] Food imports largely consist of food products not produced in Sweden, such as citrus fruits and nuts, or which are only produced during a certain time of year, like fresh vegetables and most fresh fruits, including apples. At present, the net import gap for fresh vegetables and fruits for Sweden is 83%.[66]

The total average annual Swedish agricultural production value since 2010 has been approximately €2.7 billion. Swedish crop production is dominated by cereals (mostly barley, oats and wheat); some 40% of arable land is sown with cereals. The crops covered in this study include five staple crops: OSR, wheat, barley, potatoes (industry and ware) and sugar beet. There are seven specialty crops: rye, apples, strawberries, carrots, lettuce, onions and cabbages. This study covers over two-fifths of total Swedish crop production value (Exhibit 38).[67]

64 EUROSTAT (2018).
65 Flanders Investment and Trade (2017).
66 Swedish Chambers of Trade (2011).
67 Key Swedish crops that fall out of scope are oats, other cereals and grassland, Jordbruksverket (2016).

SWEDISH FARM-LEVEL EFFECTS

The Swedish farmer currently has 31 of the 75 at-risk substances in the toolbox. The availability of the 31 at-risk substances affects two key revenue and cost determinants: the yield and the production cost (Table 14).

Of the four staple crops, Swedish ware potato farmers benefit the most from the currently available toolbox. Having a complete toolbox allows them to harvest approximately 39% more tonnes per hectare. The other staple crops enjoy 4–37% higher yields with the current toolbox The specialty crops enjoy 10–36% higher yields with the 75 substances at their disposal. The yield loss for rye farmers is low at 10% per hectare, in comparison with the other crops in scope. However, while the loss of fluroxypyr, florasulam, and clopyralid to treat dicot weeds leads only to a7% yield decrease, the substances are an important component of the farmer's resistance strategy. Moreover, it is estimated that, in the long run, yield could decrease 30%.

Swedish farmers without the current toolbox at their disposal face increased production costs, ranging between €9 per hectare for OSR and €363 per hectare for wheat. The cost hike for wheat is mostly due to the removal of triazoles of the current toolbox. Although succinate dehydrogenase inhibitors will remain available, it is expected that the fungus will quickly become resistant to this alternative.

The effect of the removal of glyphosate on production costs is considered for all Swedish crops.

68 *This data is provided by the experts.*

***Table 14**: Short-term yield and variable cost changes*[66]

Crop	Ex-farm price (€/t)	Yield			Production Cost		
		Yield WITH (t/ha)	Yield Change (Δ %)	Yield WITHOUT (t/ha)	Cost WITH (€/ha)	Cost Change (Δ €/ha)	Cost WITHOUT (€/ha)
STAPLE CROPS							
WARE POTATOES	157	43.1	−39%	26.3	5,954	145	6,099
SUGAR BEET	27	62.4	−14%	54.0	826	317	1142
INDUSTRY POTATOES	102	47.0	−37%	29.6	2,852	125	2,977
OSR	348	3.0	−21%	2.4	814	9	824
BARLEY	175	4.7	−4%	4.5	631	146	777
WHEAT	150	6.2	−11%	5.5	814	363	1,177
RYE	139	5.3	−10%	4.8	814	183	997
SPECIALTY CROPS							
CARROTS	520	58.9	−36%	37.7	22,435	99	22,534
LETTUCE	640	21.5	−16%	18.1	6,364	84	6,448
APPLES	670	16.8	−29%	12.0	6,768	256	7,024
ONIONS	130	46.2	−22%	36.1	4,473	164	4,637
STRAWBERRIES	130	7.7	−34%	5.1	250	154	404
CABBAGE	350	44.6	−19%	36.2	15,488	129	15,617

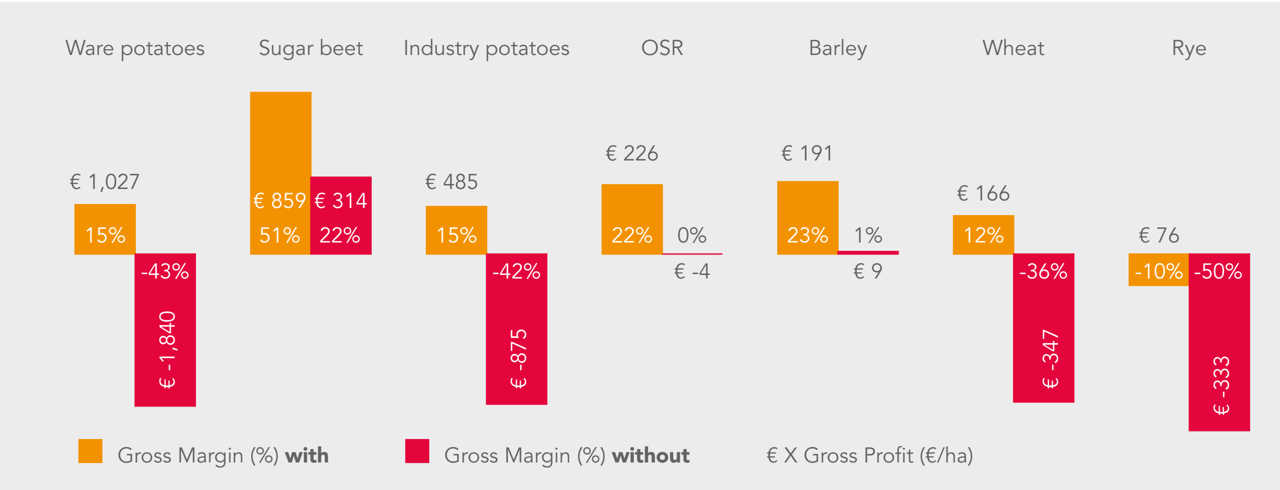


Exhibit 39*: Income effects at farm level for staple crops (in €/ha)*

For most crops, glyphosate is used in combination with mechanical weed control. Irrespective of EU regulation, the Swedish Chemical Agency is planning to tighten the rules on the private use of glyphosate. The banning of glyphosate could have serious consequences for some crops. For example, for sugar beets, other chemicals will be needed for crop rotation and will lead to a rising costs. Additionally, over the long term, weed pressure will increase, thereby weakening the efficacy of mechanical weed control.

In addition to short-term yield effects, a restricted toolbox leads to the development of long-term additional resistance. These effects on crop yields can vary between a 24% reduction in yield for barley and a complete loss of production for wheat. Furthermore, additional quality effects could arise due to a less marketable yield, which is the case for apple and onion farmers.

All Swedish staple crop farmers with the current toolbox at their disposal are able to operate with a positive gross margin, ranging from an average 12% per hectare for wheat farmers to an average 51% for sugar beets (Exhibit 39). For specialty crops, this ranges from an average of 4% per hectare for cabbage farmers to an average of 75% for strawberry farmers (Exhibit 40).[69] For the production of rye, it is not possible for Swedish farmers to operate with a positive gross margin, even with the current toolbox at their disposal.

A restricted toolbox will, however, drive down revenues and increase costs, placing pressure on the annual profitability of the other Swedish farmers as well. Sugar beet, lettuce, apple and strawberry farmers will still be able to operate at a positive gross margin. OSR, barley and onion farmers will operate close to a marginal loss without the availability of the 31 substances. Carrot, wheat, rye, potato (both industry and ware) and cabbage farmers will additionally face a gross margin loss of over 100%.

69 *Gross margin is calculated on the basis of the figures provided in the table above: ((revenue)–(costs)) / (revenue) = ((ex-farm price * yield)–(costs)) / (ex-farm price * yield).*

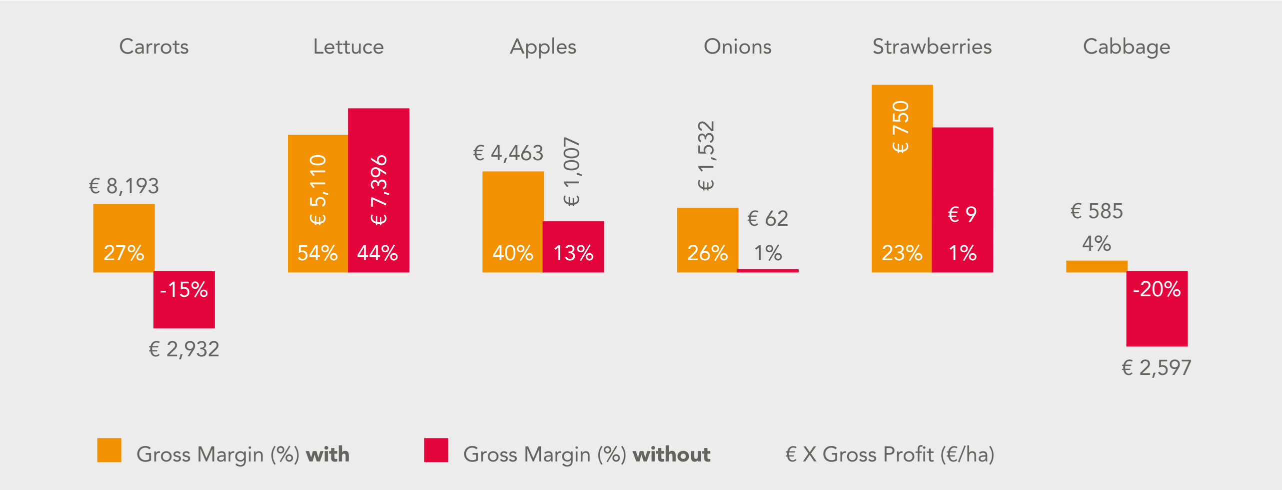


***Exhibit 40**: Income effects at farm level for specialty crops (in €/ha)*

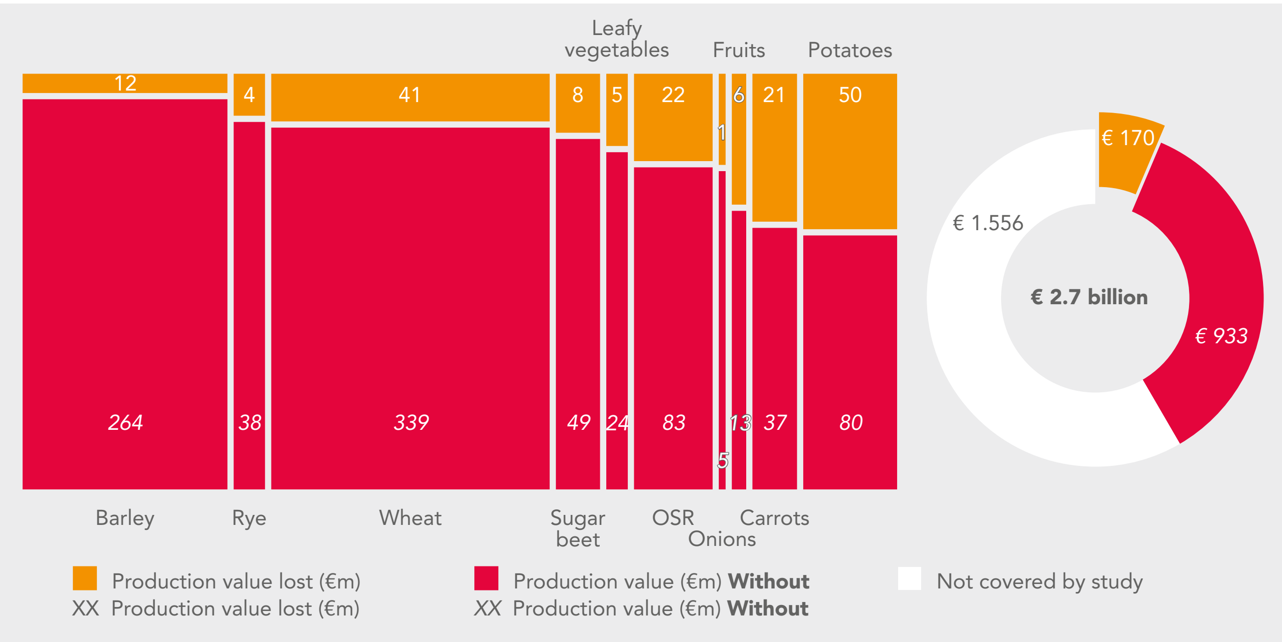


***Exhibit 41**: Total production value in scope (in € million), left; total production value (in € million), right*[69]

SWEDISH COUNTRY-LEVEL EFFECTS

The yield losses and cost increases at the Swedish farm level will translate to effects at national level. Assuming a stable annual production area, Sweden stands to lose approximately 1.2 million tonnes of crop production with a restricted toolbox.[70]

Swedish cereal producers stand to lose 0.3 million tonnes of their crop production with the restricted toolbox. This constitutes approximately 8% of total cereal production in Sweden (an average 4.4 million tonnes per year 2010–2016). Almost half of the cereal production deficit is driven by an 11% yield decrease in the production of Sweden's largest cereal crop, wheat.

For the fresh vegetables and fruits within the scope of the study, the removal of the 75 substances leads to a loss of 72,000 tonnes and €32 million in production value, which means a loss of almost 20% of annual fresh fruit and vegetable production. With a current net import gap of 83% for fresh fruits and vegetables, the phase-out of the 75 substances would put Sweden at risk of becoming completely dependent on other countries for fresh fruits and vegetables.

The loss of 1.2 million tonnes of crop production annually is equal to a loss of €174 million in production value (Exhibit 41). The total loss of production value for staple crops is approximately €57 million or 33% of total value loss. This is concomitant with the high loss in tonnes produced, with the highest loss in value (approximately half) resulting from the loss in wheat production.

70 For detailed crop production statistics, please refer to Annex 3.

71 Differences in totals are due to rounding.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Conclusion

This is the second volume of a report, the first of which was published in July 2016. Both reports attempt to look at possible socio-economic impacts on the production of seven key staple crops and 38 specialty crops in 16 EU countries under more stringent pesticide regulation. The reports reflect the opinions and knowledge of many experts. The methodology used, as well as the conclusions and opinions provided by the experts in the two reports were reviewed by agronomists and agricultural economists.

The use of pesticides is a hotly debated issue. Although the available number of active ingredients has decreased from 1,000 in the 1990s to fewer than 500 at the time of writing, there are calls to reduce this number even further. The positions taken in policy discussions regarding pesticides are often diametrically opposed. These opposite viewpoints tend to reflect the fact that different people value the environmental, food safety and economic aspects of food production differently. We focused on the economic impact of European farmers losing access to certain active substances. This does not signal that we value economic interests above environmental or social ones, but rather reflects the need to zoom in on an aspect that has received much less attention in the current policy discussions on pesticides.

The two reports explored the socio-economic impacts of removing a selected list of 75 substances, deemed as high or medium risk, from the farmers' toolbox. The results show that the removal of these pesticides would have substantially negative effects on yields and farmer incomes. For seven key staple crops the study finds significantly lower yields (10-40%). For specialty crops the negative effects are even larger: experts have estimated up to 100% yield losses for certain fruits and vegetables. Production costs per hectare would also increase. The overall effect would be a halving of farmers' incomes. In total, some € 14 billion of production value would be lost in the sixteen countries. As a result, European agriculture would become much less competitive in comparison to other parts of the world. For reasons indicated in this report and suggested by the reviewers, these numbers could be either overestimated (alternatives could be better than currently understood) or underestimated (several real effects have not been incorporated for reasons of brevity or because of difficulty to objectively quantify them). On balance, however, we believe these results to be correct, both in terms of direction and magnitude.

The findings are largely reflective of an agricultural system which emphasizes a cost-effective production of crops. This system is reliant on chemical crop protection products. There are alternative food production models in which chemical crop protection products play a less important role. An example of this is organic farming, although it should not be assumed that the pesticides it uses, which are derived from natural origin are, by default, safer for human health and the environment. Most alternative systems do not reach the same level of productivity as the current system and therefore need greater acreage, which offsets some of the environmental advantages they may have.

The point here is not to suggest that one system is better than the other, but rather to stress that any change of agricultural production will not be without tradeoffs and will require time. Change from the current system towards more sustainable and less resource intensive production methods requires not just a transition period for farmers to adopt such new methods but also for society to accept that this will lead to a less reliable availability of certain crops as well as higher food prices.

Another path might also be possible: phasing out the highest risk pesticides, but at a speed that allows the crop protection industry to bring alternatives or new products with an improved environmental and safety profile to the market. Such a period would likely take a significant amount of time, however, when looking at the slow rate with which new substances are being introduced. This is partly a consequence of the current regulations on pesticides in Europe, which have greatly increased the development time (on average 11 years) and costs of new substances. A too rapid change of pesticide regulation would lead to a reduced ability to adequately control pests. This is especially dangerous in the context of new challenges facing European farmers such as invasive alien species and climate change, causing longer and warmer growing seasons, which will likely increase pest pressure.

One of the criticisms on the many assumptions made in the two reports was that it was not realistic to assume that the original 75 substances (identified in 2014), would be removed overnight or even over a short period of time. However, looking back at our assumptions at the time, nine out of the 75 substances have not been renewed, nine substances were withdrawn or their approval expired and six substances will expire as a renewal application has not been put forward. Thus almost 1/3 of the substances will have disappeared over the course of a few years. Furthermore, several substances that were not on the list of 75 and are widely used by farmers in Europe have also been removed.

The overarching conclusion of this report therefore is that the speed of regulatory change with respect to pesticides must be synchronised to the speed at which the agricultural system and society can change or the speed at which substances with superior environmental and food safety profiles can be introduced.


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Annex 1
Methodology: calculations used in analysis

FARMER-LEVEL EFFECTS

Table 15: *Calculations used to estimate average farmer income*

INDICATOR	UNIT	EQUATION
AVERAGE CROP YIELD WITH	(t/ha)	(total country crop production output (t))/(total country crop cultivation area (ha))
REVENUE WITH	(€/ha)	average crop yield (t/ha)×average exfarm price(€/t)
GROSS PROFIT WITH	(€/ha)	revenue(€/ha)-production cost (€/ha))
GROSS MARGIN WITH	(%)	gross profit (€/ha) / revenue (€/ha)
REVENUE WITHOUT	(€/ha)	(average crop yield WITH (t/ha)×(1-yield change (%)) ×average exfarm price(€/t)
VARIABLE PRODUCTION COST WITHOUT	(€/ha)	production cost WITH (€/ha)+production cost change (€/ha)
GROSS PROFIT WITHOUT	(€/ha)	revenue WITHOUT(€/ha)-production cost WITHOUT (€/ha))
GROSS MARGIN WITHOUT	(%)	gross profit WITHOUT (€/ha) / revenue WITHOUT (€/ha)

COUNTRY-LEVEL EFFECTS

Table 16: *Calculations used to estimate country income effects*

INDICATOR	UNIT	EQUATION
PRODUCTION VALUE WITH	(€)	total country crop production output×average exfarm price(€/t)
PRODUCTION OUTPUT WITHOUT	(t)	AVERAGE CROP YIELD WITHOUT ×TOTAL COUNTRY CROP CULTIVATION AREA (HA)
PRODUCTION VALUE WITH	(€)	TOTAL PRODUCTION OUTPUT WITHOUT (T)× average exfarm price(€/t)

Table 17: *Calculations used to estimate country employment*

INDICATOR	UNIT	EQUATION
NO. OF EMPLOYED PERSONS PER CROP	(FTE)	(total employment in crop and animal production)/(total agricultural value (€)) ×total crop value (€)

EU-LEVEL EFFECTS

***Table 18**: Calculations used to estimate EU-level income*

INDICATOR	UNIT	EQUATION
AVERAGE EU FARM LEVEL		
AVERAGE YIELD WITH	(t/ha)	(total EUcrop production output (t))/(total EU crop cultivation area (ha))
AVERAGE EX-FARM PRICE	(€/t)	(total EUcrop production value (€))/(total EU crop production output (t))
REVENUE WITH	(€/ha)	average crop yield WITH (t/ha)×average ex-farm price(€/t)
PRODUCTION COST WITH	(€/ha)	weighted average of production costs of in countries in scope based on share of total output in scope
GROSS PROFIT WITH	(€/ha)	revenue WITH(€/ha)-production cost WITH (€/ha))
GROSS MARGIN WITH	(%)	gross profit WITH (€/ha) / revenue WITH (€/ha)
YIELD CHANGE	(%)	weighted average of average yield change in countries in scope based on share of total output in scope
PRODUCTION COST CHANGE	(€/ha)	weighted average of average production cost change in countries in scope based on share of total output in scope
REVENUE WITHOUT	(€/ha)	(average crop yield WITH (t/ha)× yield change (%))×average ex-farm price (€/t)
PRODUCTION COST WITHOUT	(€/ha)	production cost WITH (€/ha)+production cost change (€/ha)
GROSS PROFIT WITHOUT	(€/ha)	revenue WITHOUT(€/ha)-production cost WITHOUT (€/ha))
GROSS MARGIN WITHOUT	(%)	gross profit WITHOUT (€/ha) / revenue WITHOUT (€/ha)
EU-28 LEVEL		
PRODUCTION OUTPUT WITHOUT	(t)	AVERAGE CROP YIELD WITHOUT ×TOTAL COUNTRY CROP CULTIVATION AREA (HA)
PRODUCTION VALUE WITHOUT	(€)	TOTAL PRODUCTION OUTPUT WITHOUT (T)× average exfarm price(€/t)

Table 19: *Calculations used to estimate EU self-sufficiency*

INDICATOR	UNIT	EQUATION
EU CROP DEMAND	(t)	EU crop import (t)-EU crop export (t)
EU SELF-SUFFICIENCY WITH	(t)	EU crop production output (t)- EU crop demand (t)
EU SELF-SUFFICIENCY WITHOUT	(t)	EU crop production output WITHOUT (t)- EU crop demand (t)
LAND USE		
ADDITIONAL LAND REQUIRED	(ha)	CHANGE IN CROP YIELD(%)*(EU crop production WITH (t))/(EU average crop yield WITH (t/ha))
CARBON FOOTPRINT		
EMISSIONS WITH	(tCO_2e)	(Total GHG emissions from EU crop production)/(Total ha used for EU crop production) ×Total area used for production staple crops
EMISSIONS FROM LAND CONVERSION WITHOUT	(tCO_2e)	additional land needed (ha) × t CO_2 eq.for biomass on one ha
EMISSIONS FROM ADDITIONAL FARM INPUTS WITHOUT	(tCO_2e)	(Total GHG emissions from EU crop production)/(Total ha used for crop production EU) × Additional land needed
EMISSIONS FROM TRANSPORT WITHOUT	(tCO_2e)	demand surplus (t) ×emissions CO_2 eq.per km per tonne

Annex 2
Detailed yield and cost changes

BELGIUM

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
PEAR				**−23.7%**	**280**	**−20%**
INSECTICIDES						
APHIDS	acetamiprid thiacloprid thiamethoxam lambda-cyhalothrin	pirimicarb, flonicamid	15% 15% 0% 0%	1% 1% 0% 0%	0 0 0 0	10% 10% 0% 0%
PEAR SUCKER	thiacloprid thiamethoxam abamectin deltamethrin spinosad spirotetramat	kaolin, mineral oil, bicarbonate	25% 10% 90% 25% 0% 90%	0% 0% 0% 0% 0% 0%	0 0 0 0 0 0	0% 0% 0% 0% 0% 0%
CAPSID BUGS	thiacloprid	none	10%	1%	0	0%
LEAF ROLLER	spinosad	methoxyfenozide, fenoxycarb, indoxacarb, Bt, pheromone disruption	10%	1%	0	0%
WINTER MOTH	spinosad	methoxyfenozide, indoxacarb, Bt	10%	1%	0	0%
FUNGICIDES						
SCAB	difenoconazole tebuconazole captan thiram maneb metiram mancozeb	boscalid, dithianon, fluxapyroxad; sulphur, copper, cyprodinil, pyrimethanil, dodine, calcium polysulphide	90% 25% 100% 100% 50% 25% 50%	5% 5% 5% 5% 5% 5% 5%	0 0 0 0 0 0 0	10% 10% 25% 25% 25% 25% 25%
MILDEW	difenoconazole tebuconazole penconazole	cyflufenamid, fluopyram, fluxapyroxad, sulphur, trifloxystrobin, pyraclostrobin	10% 10% 10%	1% 1% 1%	0 0 0	10% 10% 10%
STEMPHYLIUM	captan tebuconazole	fludioxonil, trifloxystrobin, pyraclostrobin, boscalid, fluopyram, fluxapyroxad	25% 0%	1% 1%	0 0	10% 10%
STORAGE DISEASES	captan thiram thiophanate-methyl	pyrimethanil, cyprodinil, fludioxonil, pyraclostrobin, boscalid, fluopyram, imazalil	25% 0% 25%	1% 1% 1%	0 0 0	0% 0% 0%
CANCER (NECTRIA)	captan thiophanate-methyl	copper	75% 75%	0% 0%	0 0	0% 0%
HERBICIDES						
WEEDS (CONTACT)	tepraloxydim fluazifop-p-butyl gluphosinate glyphosate amitrol fluroxypyr	propyzamide, diquat	25% 25% 80% 100% 100% 0%	0% 0% 0% 0% 0% 0%	0 0 0 280 0 0	0% 0% 0% 0% 0% 0%
WEEDS (SOIL)	chlorotoluron linuron pendimethalin	diflufenican, isoxaben flazasulphuron	25% 100% 25%	0% 0% 0%	0 0 0	0% 0% 0%
DISINFECTANT	metam sodium	Dazomet, metam-potassium	5%	0%	0	0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
CARROTS				**−32.9%**	**278**	**−100%**
			INSECTICIDES			
CARROT FLY	thiamethoxam deltamethrin lambda-cyhalothrin	Coragen +Sherpa G	25% 25% 25%	0% 0% 0%	100 100 100	0% 0% 0%
APHIDS	thiacloprid lambda-cyhalothrin pirimicarb+lambda-cyhalothrin deltamethrin	Pirimor (+Spruzit+Raptol)	100% 100% 100% 100%	20% 20% 20% 20%	50 50 50 50	75% 75% 75% 75%
CATERPILLARS	lambda-cyhalothrin pirimicarb +lambda-cyhalothrin deltamethrin	Dipel +Xentari +Coragen	10% 10% 10%	0% 0% 0%	10 10 10	10% 10% 10%
			FUNGICIDES			
ALTERNARIA	tebuconazole tebuconazole +trifloxystrobin prothioconazole difenoconazole azoxystrobin +difenoconazole	Ortiva +Signum	100% 100% 100% 100% 100%	25% 25% 25% 25% 25%	0 0 0 0 0	100% 100% 100% 100% 100%
ERYSIPHE	tebuconazole tebuconazole+trifloxystrobin prothioconazole difenoconazole azoxystrobin+difenoconazole	Ortiva+Signum+Sulphur+ Reflect	100% 100% 100% 100% 100%	0% 0% 0% 0% 0%	100 100 100 100 100	50% 50% 50% 50% 50%
SCLERPOTINIA	tebuconazole +trifloxystrobin	Switch +Signum +Contans	10%	0%	100	0%
			HERBICIDES			
WEEDS	pendimethalin PRE clomazone +pendimethalin pendimethalin POST metribuzin fluazifop-p-butyl	Centium +Challenge +Novitron +Defi +others	100% 100% 100% 100% 25%	0% 0% 0% 20% 0%	750 750 750 750 750	0% 0% 0% 0% 0%
LEEKS				**−14,4%**	**412,50**	**−100,0%**
			INSECTICIDES			
MINORS	lambda-cyhalothrin spinosad abamectin abamectin		5% 5% 5% 5%	0% 0% 0% 0%	0 0 0 0	0% 0% 0% 0%
THRIPS	methiocarb lambda-cyhalothrin spinosad abamectin abamectin	Pirimor (+Spruzit+Raptol)	100% 100% 100% 100%	20% 20% 20% 20%	50 50 50 50	75% 75% 75% 75%
APHIDS	Deltamethrin	Spruzit +Raptol	0%	0%	0	0%
			FUNGICIDES			
FUSARIUM	thiophanate-methyl thiophanate-methyl		10% 10%	0% 0%	0 0	0% 0%
PUCCINIA	tebuconazole+ trifloxystrobin azoxystrobin+ difenoconazole prothioconazole tebuconazole	Otiva + Signum	100% 100% 100% 100%	0% 0% 0% 0%	75 75 75 75	100% 100% 100% 100%
PHYTOPHTHORA	mancozeb +benalaxyl-M mancozeb maneb tebuconazole +trifloxystrobin azoxystrobin +difenoconazole prothioconazole	Tanos +Ortiva +Folio Gold +Prevint +Signum +Infinito	75% 75% 75% 75% 75% 75%	0% 0% 0% 0% 0% 0%	25 25 25 25 25 25	40% 40% 40% 40% 40% 40%
			HERBICIDES			
WEEDS	pendimethalin dimethenamid-p chlorpropham seedbed	Butisan +Defi +Bromotryl +Lentagran +AZ	100% 100% 100%	0% 0% 0%	0 0 0	0% 0% 0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
PEAS				**0,0%**	**0**	**−60,0%**
INSECTICIDES						
APHIDS	thiacloprid deltamethrin lambda-cyhalothrin pirimicarb +lambda-cyhalothrin spirotetramat	Plenum +Cytrhin +Fastac +Fury +Pirimor +Spruzit +Raptol +Teppeki	100% 100% 100% 100% 100%	0% 0% 0% 0% 0%	0 0 0 0 0	10% 10% 10% 10% 10%
THRIPS	lambda-cyhalothrin deltamethrin pirimicarb+lambda-cyhalothrin	Fastac+Spruzit+Raptol	20% 20% 20%	0% 0% 0%	0 0 0	0% 0% 0%
PEA LEAF BEETLE	deltamethrin lambda-cyhalothrin pirimicarb +lambda-cyhalothrin	Fastac +Cytrin	10% 10% 10%	0% 0% 0%	0 0 0	0% 0% 0%
PEA MOTH	lambda-cyhalothrin pirimicarb+lambda-cyhalothrin	Fastac+Fury	5% 5%	0% 0%	0 0	0% 0%
FUNGICIDES						
GERM FUNGUS	thiram	Wakil	0%	0%	0	0%
BOTRYTIS	iprodione metconazole	Bravo, Ortiva, Switch, Cantus, Luna Privilege	20% 20%	0% 0%	0 0	0% 0%
SCLEROTINIA	iprodione gebr. 5/6/2018 thiophanate-methyl	Switch, Cantus, Luna Privilege	20% 20%	0% 0%	0 0	50% 50%
PERONOSPORA	dimethomorph+mancozeb cymoxanil+mancozeb		75% 75%	0% 0%	0 0	0% 0%
UROMYCES PISI	metconazole	Ortiva	5%	0%	0	0%
HERBICIDES						
WEEDS	clomazone +pendimethalin pendimethalin MCPB fluazifop-p-butyl	Novitron, Centium, Challenge Basagran, Corum a lot of others available	100% 100% 100% 100%	0% 0% 0% 0%	0 0 0 0	0% 0% 0% 0%
BEANS				**−7,1%**	**300**	**−7,1%**
INSECTICIDES						
APHIDS	thiacloprid deltamethrin lambda-cyhalothrin spirotetramat pirimicarb +lambda-cyhalothrin	Cythrin, Pirimor, Spruzit, Raptol	10% 10% 10% 10% 10% 10%	0% 0% 0% 0% 0% 0%	0 0 0 0 0	10% 10% 10% 10% 10% 10%
MINORS	spinosad		0%	0%	0	0%
CATERPILLARS	deltamethrin lambda-cyhalothrin pirimicarb +lambda-cyhalothrin spinosad	Steward, Spruzit, Dipel, Xentari, Affirm	5% 5% 5% 5%	0% 0% 0% 0%	0 0 0 0	0% 0% 0% 0%
THRIPS	spinosad	Raptol	5%	0%	0	0%
FUNGICIDES						
GERM FUNGUS			100%	5%	0	0%
UROMYCES			0%	0%	0	0%
BOTRYTIS			100%	0%	100	0%
SCLEROTINIA			100% 100%	0% 0%	100 100	0% 0%
HERBICIDES						
WEEDS						

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
APPLES				−4.0%	280	−26.8%
INSECTICIDES						
APHIDS	acetamiprid imidacloprid thiacloprid	pirimicarb, flonicamid	50% 20% 50%	1% 1% 1%		25% 25% 25%
WOOLLY APHID	spirotetramat	mineral oil, pirimicarb	90%	0%		0%
CAPSID BUGS	thiacloprid		10%	1%		0%
LEAF ROLLER	spinosad	methoxyfenozide, fenoxycarb, indoxacarb, Bt, pheromone disruption	10%	1%		0%
WINTER MOTH	spinosad	methoxyfenozide, indoxacarb, Bt	10%	1%		0%
FUNGICIDES						
SCAB	difenoconazole tebuconazole captan thiram maneb metiram mancozeb	boscalid, dithianon, fluxapyroxad; sulphur, copper, cyprodinil, pyrimethanil, dodine, calcium polysulphide	90% 25% 100% 100% 50% 25% 50%	5% 5% 5% 5% 5% 5% 5%		10% 10% 25% 25% 25% 25% 25%
MILDEW	difenoconazole tebuconazole penconazole	cyflufenamid, fluopyram, fluxapyroxad, sulphur, trifloxystrobin, pyraclostrobin	10% 10% 10%	1% 1% 1%		10% 10% 10%
STORAGE DISEASES	captan thiram thiophanate-methyl	pyrimethanil, cyprodinil, fludioxonil, pyraclostrobin, boscalid, fluopyram, imazalil	25% 0% 25%	1% 1% 1%		0% 0% 0%
CANCER	captan thiophanate-methyl	copper	75% 75%	0% 0%		0% 0%
HERBICIDES						
WEEDS (CONTACT)	tepraloxydim fluazifop-p-butyl gluphosinate glyphosate amitrol fluroxypyr	propyzamide	25% 25% 80% 100% 50% 0%	0% 0% 0% 0% 0% 0%	280	0% 0% 0% 0% 0% 0%
WEEDS (SOIL)	chlorotoluron linuron pendimethalin	diflufenican, isoxaben, flazasulphuron	25% 50% 25%	0% 0% 0%		0% 0% 0%
DISINFECTANT	metam sodium	dazomet, metam-potassium	20%	0%		0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
LETTUCE				**−25.0%**	**700**	**0.0%**
		INSECTICIDES				
APHIDS	imidacloprid, thiamethoxam, lambda-cyhalothrin, deltamethrin	Piperonlyl butoxide, pyrethrin, rapeseed oil, spirotetramat, acetamiprid, pymetrozine, pirimicarb	100%	0%	0	0%
LEAF MINER	spinosad, abamectin	cyromazine	40%	0%	0	0%
CATERPILLARS	deltramethrin, lambda-cyhalothrin, spinosad	Bacillus thuring. spp. aizawai, Bacillus thuring. spp. kurstaki, chlorantraniliprole, piperonyl butoxide +pyrethrin, indoxacarb	65%	25%	0	0%
		FUNGICIDES				
BOTRYTIS	thiram	Gliocladium catenulatum J1446, Bacillus amyloliquefaciens, Bacillus subtilis str QST 713, fenhexamid, cyprodinil +fludioxonil, fluopyram, fluopyram +trifloxystrobin, boscalid +pyraclostrobin	100%	0%	200	0%
BREMIA LACTUCAE	mandipropamid, mancozeb	fenamidone+fosethl, dimethomorph, propamocarb, azoxystrobin	100%	0%	500	0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
MAIZE				**−29.2%**	**25.50**	**0.0%**
		INSECTICIDES				
	Deltamethrin		2%	2%	0	0%
	Lambda-cyhalothrin		2%	2%	0	0%
		HERBICIDES				
	Clopyralid		5%	2%	0	0%
	Dimethenamid-P		50%	30%	15	0%
	Fluroxypyr		5%	2%	0	0%
	Gluphosinate		5%	10%	30	0%
	Glyphosate		5%	10%	30	0%
	Pendimethalin		50%	30%	15	0%
	S-metolachlor		50%	30%	15	0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
STRAWBERRIES				−15.0%	3,166	−90%
INSECTICIDES						
SPIDER MITE	abamectin	bifenazate, tebufenpyrad,etoxazole, pyrethrin, spirodiclofen, biological control	100%	5%	620	5%
THRIPS	abamectin spinosad lambda-cyhalothrin metiocarb	pyrethrin, biological control	89% 89% 100% 36%	5% 5% 5% 5%	20 43 100 −21	10% 5% 30% 30%
APHIDS	lambda-cyhalothrin spirotetramat thiacloprid	pirimicarb, pyrimetrozine	100% 100% 100%	5% 5% 5%	213 56 74	30% 30% 30%
CATERPILLARS	lambda-cyhalothrin	bacillus thuringiënsis, indoxacarb	100%	5%	284	30%
FUNGICIDES						
VERTICILLIUM AND NURSERY PLANT DETERIORATION IN COLD STORAGE	Thiophanate-methyl		74%	5%		10%
BOTRYTIS	iprodione thiram captan	fluopyram, cyprodinyl+fludioxonil, boscalid+pyraclostrobin	68% 100% 100%	5% 5% 5%	356 370 715	30% 30% 10%
POWDERY MILDEW	myclobutanil penconazole quinoxyfen	boscalid +pyraclostrobin, fluopyram +trifloxystrobin	100% 100% 100%	5% 5% 5%	−198 259 302	5% 10% 5%
HERBICIDES						
NEMATODES AND FUNGI	Metam sodium	dazomet, metam potassium	63%	5%	43,02	30%
GRASSES IN STRAWBERRIES	flusifop-p-butyl	weeding between the plants, quizalofop-ethyl-D	69%	5%	28	20%
WEEDS IN THE OPEN-FIELD CULTURE OF STRAWBERRIES	gluphosinate S-metolachlor pendimethalin	weeding between the plants, diquat napropamid	59% 59% 59%	5% 5% 5%	11,188 47,124	20% 30% 5%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
POTATOES				−11.9%	953	
INSECTICIDES						
	deltamethrin esfenvalerate 25 g/l lambda-cyhalothrin thiamethoxam 25% thiacloprid 240 g/l spinosad metam-sodium	acetamiprid alphacypermethrin, cypermethrin esfenvalerate flonicamide, paraffin oil, piperonyl butoxyde pyrethrins pymetrozine, tau-fluvalinate, thiacloprid zeta-cypermethrin , azadirachtin, beta-cyfluthrin, chlorantraniliprole, esfenvalerate, gamma-cyhalothrin, lambda-cyhalothrin + pirimicarb, phosmet, OSR, spinosad thiamethoxam	6% 2% 25% 4% 10% 2% 0,5%	0% 0% 0% 15% 15% 15% 50%	- - - - 0 0 -	23% 23% 23% 30% 30% 20% 25%
FUNGICIDES						
	mancozeb manb difenoconazole fluazinam mandipropamid	maneb, chlorothalonil, fluazinam, fluazinam + azoxystrobin, amisulbron, cyazofamid, difenoconazole + mandipropamid, dimethomorph, dimethomorph + fluazinam, dimethomorph + pyraclostrobin, dimethomorph + ametoctradin, dimethomorph + zoxamide, mandipropamid, metalaxyl-M + fluazinam, azoxystrobin, azoxystrobin + fluazinam, boscalid + pyraclostrobin, difenoconazole, difenoconazole + mandipropamid, dimethomorph + pyraclostrobin	95% 85% 75% 70% 95%	1% 1% 1% 1% 1%	50 50 50 35 20	25% 25% 25% 13% 13%
HERBICIDES						
	chlorpropham glyphosate pendimethalin metribuzin metribuzin	1,4-dimethylnaphtalene, ethylene, peppermint oil, maleic hydrazide	80% 35% 10% 80% 20%	0% 2% 0% 10% 25%	900 98 25 25 25	0% 0% 0% 30% 30%

DENMARK

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
WHEAT				**−14%**	**17.18**	**−-3%**
		INSECTICIDES				
APHIDS, ORANGE WHEAT BLOSSOM MIDGE	lambda-cyhalothrin	alpha-cypermethrin, tau-fluvalinate				
		FUNGICIDES				
SEED TREATMENT FOLIAR DISEASES	triazoles	fludioxonil	95%	0%		0%
SEED TREATMENT, TAKE-ALL	silthiopham	no alternatives	3%	5%		0%
SEPTORIA	triazoles	strobilurins	100%	10%		1%
RUST	triazoles	strobilurins	35%	2%		0%
POWDERY MILDEW	triazoles	metrafenone	15%	10%		1%
DTR (ONLY REDUCED TILLAGE AND PRE-CROP WHEAT)	triazoles	no alternatives	5%	10%		0%
		HERBICIDES				
ANNUAL DICOT WEEDS	fluroxypyr	ALS-inhibitors, auxins, diflufenican, bromoxynil	98%	0%	1.00	2%
ANNUAL GRASS WEEDS	pendimethalin	ALS-inhibitors, prosulphocarb, diflufenican, ACCase-inhibitors	95%	0%		0%
PERENNIAL WEEDS, E.G. THISTLES AND COUCH	glyphosate	sulphosulphuron against couch, tribenuron, MCPA, 2,4-D and aminopyralid against thistles	25%	2%		0%
GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	no chemical alternatives	75%	0%		0%
GLYPHOSATE FOR DESICCATION IN FODDER WHEAT	glyphosate	no chemical alternatives	15%	0%		0%
GLYPHOSATE AS A PREREQUISITE FOR REDUCED TILLAGE	glyphosate	no chemical alternatives	15%	0%		0%
OSR				**−10%**	**82.83**	**−19%**
		INSECTICIDES				
SEED TREATMENT INSECTICIDES, USED PRIMARILY AGAINST PHYLLIODES CHRYSOCEPHALA AND TUYV	neonicotinoids	no seed treatment alternatives, tau-fluvalinate and cypermethrin available post-emergence insecticides	90%	−3%		−18%
		FUNGICIDES				
POLLEN BEETLES CABBAGE SEED WEEVIL AND POD MIDGE	thiacloprid, lambda-cyhalothrin	tau-fluvalinate, indoxacarb, pymetrozine	25% 60%	0% 4%		1% 3%
PHOMA AUTUMN GROWTH REGULATION SCLEROTINIA SCLEROTIORUM SPRING GROWTH REGULATION	triazoles	boscalid no alternatives azoxystrobin, picoxystrobin, boscalid no alternatives	10% 20% 85% 35%	0% 8% 4% 0%		0% 0% 0% 0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
HERBICIDES						
ANNUAL DICOT WEEDS	clopyralid, picloram, pendimethalin	clomazone	80%	3%		1%
PERENNIAL WEEDS, E.G. THISTLES AND COUCH	clopyralid	propaquizafop, cycloxidim	25%	0%		0%
GLYPHOSATE FOR DESICCATION GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	diquat no chemical alternatives	20% 100%	0% 0%		0% 0%
SPRING BARLEY				−6%	68.13	−4%
INSECTICIDES						
APHIDS, OULEMA MELANOPUS	lambda-cyhalothrin	alpha-cypermethrin, tau-fluvalinate	50%	0%		0%
FUNGICIDES						
SEED BORNE DISEASES FOLIAR DISEASES, EARLY CONTROL FOLIAR DISEASES, LATE CONTROL	triazoles	no alternatives metrafenone, azoxystrobin, picoxystrobin, pyraclostrobin azoxystrobin, picoxystrobin, pyraclostrobin	100% 30% 95%	0% 0% 5%		0% 0% 2%
HERBICIDES						
DICOT WEEDS	fluroxypyr	ALS-inhibitors, auxins, diflufenican, bromoxynil	98%	0%		2%
PERENNIAL WEEDS, E.G. THISTLES AND COUCH GLYPHOSATE FOR DESICCATION IN FODDER BARLEY GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	tribenuron, MCPA, 2,4-D and aminopyralid against thistles no chemical alternatives, only shallow tillage no chemical alternatives	25% 15% 75%	3% 0% 0%		0% 0% 0%
WINTER BARLEY				−5%	68.19	−4%
INSECTICIDES						
APHIDS AUTUMN (BYDV)	lambda-cyhalothrin	alpha-cypermethrin, tau-fluvalinate	35%	0%		1%
FUNGICIDES						
FOLIAR DISEASES, EARLY CONTROL FOLIAR DISEASES, LATE CONTROL	triazoles	metrafenone, azoxystrobin, picoxystrobin, pyraclostrobin azoxystrobin, picoxystrobin, pyraclostrobin	40% 95%	0% 4%		0% 2%
HERBICIDES						
DICOT WEEDS	fluroxypyr	ALS-inhibitors, auxins, diflufenican, bromoxynil	98%	0%		2%
GRASS WEEDS	pendimethalin	ALS-inhibitors, prosulphocarb, diflufenican, ACCase-inhibitors	95%	0%		0%
PERENNIAL WEEDS, E.G. THISTLES AND COUCH GLYPHOSATE FOR DESICCATION GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	tribenuron, MCPA, 2,4-D and aminopyralid against thistles no chemical alternatives, only shallow tillage no chemical alternatives	25% 15% 75%	3% 0% 0%		0% 0% 0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
RYE				**−3%**	**51.82**	**−3%**
INSECTICIDES						
APHIDS AUTUMN (BYDV)	lambda-cyhalothrin	alpha-cypermethrin, tau-fluvalinate	30%	0%		0%
FUNGICIDES						
FOLIAR DISEASES, EARLY CONTROL	triazoles	metrafenone, azoxystrobin, picoxystrobin, pyraclostrobin	20%	0%		1%
FOLIAR DISEASES, LATE CONTROL	triazoles	azoxystrobin, picoxystrobin, pyraclostrobin	90%	3%		1%
HERBICIDES						
DICOT WEEDS	fluroxypyr	ALS-inhibitors, auxins, diflufenican, bromoxynil	98%	0%		2%
GRASS WEEDS	pendimethalin	ALS-inhibitors, prosulphocarb, diflufenican, ACCase-inhibitors	95%	0%		0%
PERENNIAL WEEDS, E.G. THISTLES AND COUCH	glyphosate	sulphosulphuron against couch, tribenuron, MCPA, 2,4-D and aminopyralid against thistles	25%	2%		0%
GLYPHOSATE FOR DESICCATION	glyphosate	no chemical alternatives, only shallow tillage	15%	0%		0%
GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	no chemical alternatives	75%	0%		0%
MAIZE				**−1%**	**12.93**	**−1%**
FUNGICIDES						
FOLIAR DISEASES	triazoles	pyraclostrobin	20%	1%		5%
HERBICIDES						
GLYPHOSATE PRE-EN	Glyphosate	no chemical alternatives, only shallow tillage	10%	0%		0%
GLYPHOSATE AS A PREREQUISITE FOR REDUCED TILLAGE	Glyphosate	no chemical alternatives, only shallow tillage	15%	0%		0%
GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	Glyphosate	mestotrione, AlS-inhibitors	25%	2%		0%
GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	Glyphosate	no chemical alternatives	75%	0%		0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
SUGAR BEET				**−15%**	**163.79**	**−4%**
INSECTICIDES						
SEED TREATMENT (NEONIC)	imidacloprid	only pirimicarb for post-emergence spraying	100%	3%		2%
FUNGICIDES						
SEED TREATMENT (FUNGICIDES)	hymexazol, thiram	no alternatives	100%	1%		0%
FOLIAR DISEASES	triazoles	strobilurins	100%	8%		2%
HERBICIDES						
DICOT WEEDS	ethofumesate, clopyralid, triflusulphuron	phenmedipham, metamitron, clomazone	75%	2%		0%
DICOT PERENNIAL WEEDS	clopyralid	no alternatives	0%	0%		0%
GLYPHOSATE FOR CONTROL OF COUCH (IN CROP ROTATION) GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	propaquizafop, cycloxydim no chemical alternatives	30% 70%	5% 0%		0% 0%
GRASS SEEDS				**−5%**	**8.67**	**−2%**
FUNGICIDES						
FOLIAR DISEASES	triazoles	azoxystrobin, picoxystrobin, pyraclostrobin	75%	5%		2%
HERBICIDES						
DICOT WEEDS FOLIAR DISEASES	clopyralid, pendimethalin, fluroxypyr	ALS-inhibitors, auxins, diflufenican	40% 0%	1% 0%		1% 0%
COUCH IN RYEGRASS AND MEADOWGRASS	glyphosate	no chemical alternatives in most species. Fob-/dim are alternative in red fescue	65%	2%		0%
POTATOES				**−1%**	**18.20**	**0%**
INSECTICIDES						
TREATMENT OF SEED TUBERS	imidacloprid	only spraying post-emergence with acetamiprid, flonicamid	36%	2%		0%
FUNGICIDES						
LATE BLIGHT	mancozeb	cyazofamid, mandipropamid, propamocarb, cymoxanil	100%	0%		0%
ALTERNARIA LEAF BLIGHT	mancozeb	azoxystrobin, pyraclostrobin, boscalid	100%	0%		0%
PREVENTION OF SPROUTING DURING STORAGE	chlorpropham	peppermint oil	0%	0%		0%
HERBICIDES						
GLYPHOSATE PRE-EN GLYPHOSATE FOR CONTROL OF COUCH GLYPHOSATE FOR CONTROL OF THISTLES AND OTHER PERENNIAL WEEDS IN CROP ROTATION AFTER HARVEST	glyphosate	Diquat propaquizafop, cycloxydim no chemical alternatives	75% 25% 75%	0% 1% 0%		0% 0% 0%

FINLAND

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
OATS				**−18.0%**	**52.10**	**−46.0%**
INSECTICIDES						
APHIDS & VIRUSES	5 a.i.'s	Mavrik	10%	−50%		−100%
FUNGICIDES						
FUSARIUM, LEAF SPOTS, RUSTS	8 a.i.'s in different formulations	Amistar, Comet	40%	−10%		−20%
FUNGICIDES						
COUCH GRASS	all glyphosate products	none	50%	−10%		0%
DIFFICULT BLWS	3 a.i.'s	many	80%	−5%		−35%
SPRING BARLEY				**−34.1%**	**60.30**	**−153.5%**
INSECTICIDES						
APHIDS & VIRUSES	5 a.i.'s	Mavrik	10%	−30%		−100%
FUNGICIDES						
SMUT	3 a.i.'s in different formulations	none with good enough effect	100%	−5%		−30%
FUSARIUM	2 a.i.'s	none	20%	−5%		−20%
LEAF SPOTS	8 a.i.'s	Amistar, Comet, ElatusPlus	80%	−10%		−60%
HERBICIDES						
DIFFICULT BLWS	3 a.i.'s in different formulations	many	90%	−10%		−35%
COUCH GRASS	all glyphosate products	none	50%	−15%		0%
WILD OATS	1 a.i.	Puma, Attribut, Tombo, Broadway	30%	−2%		−100%
SPRING WHEAT				**−276%**	**61.77**	**−197.5%**
INSECTICIDES						
APHIDS, MIDGES		Mavrik	100%	−5%		−100%
FUNGICIDES						
FUSARIUM	2 a.i.'s	none	30%	−5%		−20%
LEAF SPOTS	8 a.i.'s in different formulations	Amistar, Comet, ElatusPlus	50%	−10%		−60%
HERBICIDES						
DIFFICULT BLWS	3 a.i.'s in different formulations	many	90%	−10%		−35%
COUCH GRASS	all glyphosate products	none	50%	−13%		0%
WILD OATS	1 a.i.	Puma, Attribut, Tombo, Broadway	30%	−2%		−100%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
WINTER WHEAT				**−27.6%**	**43.35**	**−197.5%**
		INSECTICIDES				
APHIDS, MIDGES		Mavrik	100%	−5%		−100%
		FUNGICIDES				
FUSARIUM	2 a.i.'s	none	30%	−5%		−20%
LEAF SPOTS	8 a.i.'s in different formulations	Amistar, Comet, ElatusPlus	50%	−10%		−60%
		HERBICIDES				
DIFFICULT BLWS	3 a.i.'s in different formulations	many	90%	−10%		−35%
COUCH GRASS	all glyphosate products	none	50%	−13%		0%
WILD OATS	1 a.i.	Puma, Attribut, Tombo, Broadway	30%	−2%		−100%
WINTER RYE				**−17%**	**19**	**−60%**
		INSECTICIDES				
FRITT FLY	5 a.i.'s	Mavrik	30%	−5%		−20%
SNOW MOLD	1 a.i.	Amistar	30%	−30%		−60%
RUSTS	8 a.i.'s in different formulations	Amistar, Comet, ElatusPlus	30%	−5%		−60%
		HERBICIDES				
DIFFICULT BLWS	3 a.i.'s in different formulations	many	90%	−5%		−20%
OSR				**−62.0%**	**6**	**60.0%**
		INSECTICIDES				
FLEA BEETLES	5 a.i.'s	Mavrik	100%	−25%		0%
FLEA BEETLES, BLOSSOM BEETLE	5 a.i.'s	Avaunt, Mavrik, Plenum	100%	−30%		30%
		FUNGICIDES				
SCLEROTINIA	6 a.i.'s	Amistar	30%	−10%		100%
		HERBICIDES				
DIFFICULT BLWS	1 a.i.	5 a.i.'s	30%	−5%		0%
COUCH GRASS	all glyphosate products	none	50%	−5%		0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
POTATOES				**−44.5%**	**25**	**−199.0%**
		INSECTICIDES				
APHIDS (VIRUSES)	5 a.i.'s	Mavrik, Teppeki, Sunoco	30%	−10%		−80%
LATE BLIGHT	4 a.i.'s	Consento, Cymbal, Infinito, Leimay, Ranman	100%	−20%		−100%
EARLY BLIGHT	1 a.i.	Amistar, Signum	40%	−10%		−100%
		HERBICIDES				
WEEDS	1 a.i.	Boxer, Fenix, Monitor, Titus	100%	−10%		−20%
GLYPHOSATE	all glyphosate products	none	50%	−15%		−30%
	1 a.i.'s	Spotlight	70%	0%		0%
CARAWAY				**−29.5%**	**58,50**	**85.0%**
		HERBICIDES				
BLW	3 a.i.'s	Boxer, Fenix, Goltix, Lentagran	100%	−10%		0%
COUCH GRASS	all glyphosate products	none	50%	−5%		0%
		INSECTICIDES				
CARAWAY MOTH	2 a.i.'s	Mavrik, Turex	85%	−20%		100%
CARROTS				**−113%**	**2,132**	**125%**
		INSECTICIDES				
TRIOZA APICALIS	6 a.i.'s	none	70%	−50%		80%
CARROT FLY	6 a.i.'s	none	70%	−30%		0%
		FUNGICIDES				
LEAF & STORAGE DISEASES	1 a.i.	Mycostop, Serenade, Amistar, Signum	80%	−40%		80%
		HERBICIDES				
BLW WEEDS	3 a.i.'s	Fenix	100%	−20%		5%
COUCH GRASS	all glyphosate products		50%	−10%		0%
STRAWBERRIES				**−53%**	**4.970**	**104%**
		INSECTICIDES				
	Couch grass	herbicide	60%	−20%		0%
	Sonchus, Cirsium	herbicide	10%	−20%		0%
		FUNGICIDES				
MILDEW	1 a.i.	Amistar, Candit, Frupica, Serenade	30%	−10%		60%
		HERBICIDES				
INSECTS	4 a.i.'s	nematodes	100%	−30%		80%
MITES	1 a.i.	Envidor, Floramite, Nissorun, beneficials	30%	−20%		20%

GREECE

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
CITRUS FRUITS				**−25%**	**250**	**19%**
INSECTICIDES						
	Neonicotinoids	deltamethrin, phosmet, spirotetramat, paraffin oil, fatty acid potassium salt	75%	5%	100	0
HERBICIDES						
	Glyphosate	Flazasulphuron, florasulam, napropamid, penoxsulam, propaquizafop, quizalofop-p-ethyl	95%	15%	150	20%
	ED	FOSETYL-AL, copper	65%	10%	50	0
GRAPES				**−27%**	**500**	
INSECTICIDES						
	Neonicotinoids	Beta-cyfluthrin, Deltamethrin, lambda-Cyhalothrin (αποαααααααα), Cypermethrin	75%	10%	350	0%
HERBICIDES						
	Glyphosate	Flumioxazin, Gluphosinate-ammonium, Pendimethalin (αποαααααααα), Diquat, Flazasulphuron, Propaquizafop, Propyzamide	95%	15%	200	20%
	ED	ametoctradin, azoxystrobin, benalaxyl, cymoxanil, dimethomorph, famoxadone, fosetyl, iprovalicarb, kresoxim-methyl, metalaxyl, propineb, trifloxystrobin, zoxamide, copper	95%	5%	50	0%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
PEACHES				**−35%**	**275**	
INSECTICIDES						
	Neonicotinoids	acetamiprid, chlorantraniliprole, chlorpyrifos, chlorpyrifos-methyl, flonicamid, paraffin oil, pirimicarb, pyrethrins, fatty acid potassium salt, taufluvalinate, bacillus strains	100%	−40%	100	40–50%
		paraffin oil, chlorantraniliprole, bacillus, chlorpyrifos, chlorpyrifos-methyl, etonfenprox, fatty acid potassium salt, indoxacarb, methoyifenozide, tau-fluvalinate, αμααα Decen, αμααα dodecen, emamectin, phosmet, spinetoram, GPGV, fenoxycarb, Beauveria bassiana, methoxyfenozide, hydrolyse proteins, pyriproxifen, formetanate, flomicanid, pirimicarb, acequinocyl, etoxazole, spirodiclofen, tebufenpyrad, acetamiprid, pyrethrins, pymetrozine, acrinathrin, formetanate	100%	0%	40	0%
FUNGICIDES						
		Copper hydroxide, copper oxychloride, fluopyram, bordeaux mixture, dodine, ziram, diathianon, pyraclostrobin, fludioxonil, boscalid, sulphur, chlorothalonil, cyprodinil, Trichoderma strains, bacillus strains, tribasic copper sulphate, fluxapyroxad, quinoxyfen, trifloxystrobin	100%	−20%	60	20–30%
HERBICIDES						
	Glyphosate	Napropamid, propaquizafop, quizalofop-p-ethyl, propyzamide, MCPA	100%	−40%	75	30–50%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
PEARS				**−65%**	**445**	
INSECTICIDES						
	Neonicotinoids (Imidacloprid)	acrinathrin, aluminium silicate, beauveria bassiana strain, chlorantraniliprole, chloropyrifos-methyl, cypermethrin, fatty acid potassium, fenoxycarb, paraffin oil, tau-fluvalinate,	100%	−5%	150	5–10%
			100%	−10%	200	20–30%
FUNGICIDES						
				−10%	20	20–30%
HERBICIDES						
	Glyphosate	napropamid, propaquizafop, quizalofop-p-ethyl, cycloxidin, propyzamide, diflufenican, MCPA, diquat	100%	−40%	75	30–50%
APPLES				**−65%**	**375**	
INSECTICIDES						
	Neonicotinoids	acetamiprid, flodicanil, paraffin oil, pirimicarb, tau-fluvalinate, azadirachtin	100%	−5%	80	10–25%
			100%	−10%	200	20–30%
FUNGICIDES						
		Boscalid, cyprodinil, fludioxonil, fluopyram, penthiopyrad, copper oxychloride, Aureobasidium, Bacillus, copper hydroxide, copper oxide, tribasic copper sulphate, fosetyl, laminarin, diathianon, dodine, pyraclostobine, ziram, imazalil, thiabendazole, pyrimethanil, Trichoderma, kresoxim-methyl, trifloxystrobin, potassium phosphonates, sulphur, propineb,thiabendazole, bordeaux mixture, triandimenol	100%	−10%	20	20–30%
HERBICIDES						
	Glyphosate	Napropamid, propaquizafop, quizalofop-p-ethyl, cycloxidin, propyzamide, diflufenican,MCPA, diquat,	100%	−40%	75	30–40%
ONIONS				**−49%**	**472**	**0%**

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
COTTON				**−43%**	**2,200**	
INSECTICIDES						
	Neonicotinoids	Methomyl, chlorpyrifos chlorpyrifos-methyl, pirimicarb, tau-fluvalinate	100%	40%	400	50%
		Acetamiprid bacillus thuringiensis, chlorantraniliprole, chlorpyrifos, chlorpyrifos-methyl, cypermethrin, diflubenzuron, emamectin, flonicamid, Helicoverpa armigera nuclear polyhedro virus, indoxacarb, Metaflumizone, methomyl, pirimicarb, pymetrozine, pyriproxyfen, spinetoram, taufluvalinate, tefluthrin zeta-cypermethrin	100%	30%	550	50%
HERBICIDES						
	Glyphosate	Benfluralin clethodim, cycloxydim, propaquizafop propyzamide zuizalofop-ethyl, quizalofop-p-ethyl quizalofop-p-tefuryl	100%	60%	1250	40%
OLIVES				**−20%**	**230**	
INSECTICIDES						
	thiacloprid, thiamethoxam		0%	0%		0%
	beta-cyfluthrin, deltamethrin, dimethoate, lambda-cyhalothrin, spinosad, spirotetramat		100%	−20%	100	45%
FUNGICIDES						
	difenoconazole, fenbuconazole, mancozeb, tebuconazole	Bordeaux mixture, copper hydroxide, copper oxide, copper oxychloride, dodine, tribasic copper sulphate, Trichoderma asperellum strain ICC012, Trichoderma gamsii (formerly T. viride) strain ICC, Trifloxystrobin	100%	−20%	60	25%
HERBICIDES						
	Glyphosate	diflufenican, flazasulphuron, florasulam, gluphosinate-ammonium, Iodosulphuron, MCPA, mefenpyr, penoxsulam, tribenuron	100%	−20%	70	30%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
CUCUMBER				**−20%**	**300**	
INSECTICIDES						
	imidacloprid, thiacloprid, thiamethoxam,		0%	0%		0%
	Abamectin (aka avermectin), beta-cyfluthrin, deltamethrin, lambda-cyhalothrin, Methiocarb, Spinosad, Spiromesifen, Spirotetramat		100%	−20%	200	35%
FUNGICIDES						
			100%	−20%	100	25%
TOMATOES				**−20%**	**300**	
INSECTICIDES						
	imidacloprid, thiacloprid, thiamethoxam		0%	0%		0%
	Abamectin (aka avermectin), deltamethrin, dimethoate, esfenvalerate, lambda-Cyhalothrin, methiocarb, spinosad, spiromesifen, spirotetramat		100%	−20%	200	45%
FUNGICIDES						
	bupirimate, captan, difenoconazole, folpet, iprodione, mancozeb, mandipropamid, myclobutanil, penconazole, tebuconazole, thiophanate-methyl, triadimenol		100%	−20%	100	30%
HERBICIDES						
	Glyphosate		0%	0%		0%
	fluazifop-p-butyl, Metribuzin, Pendimethalin, S-metolachlor	Clethodim, cycloxydim, napropamid. propaquizafop, quizalofop-ethyl, quizalofop-p-tefuryl, rimsulphuron	100%	−20%		25%

HUNGARY

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
WINTER WHEAT				−36%	209,32	
INSECTICIDES						
ZABRUS TENEBRIOIDES	imidacloprid	difenoconazole +fludioxonil +thiamethoxam, alphamethrin, tefluthrin, chlorpyrifos, cypermethrin	10%	−20%	116,80	
GRUBS	imidacloprid	tefluthrin	10%	−20%	116,80	100
OULEMA SPP.	beta-cyfluthrin deltamethrin esfenvalerate lambda-cyhalothrin thiacloprid	alphamethrin, cypermethrin, gamma-cyhalothrin, chlorpyrifos, tau-fluvalinate, zeta-cypermethrin	2% 15% 5% 15% 5%	−1% −1% −1% −1% −1%	5,84 5,84 5,84 5,84 5,84	
APHIDS	beta-cyfluthrin deltamethrin esfenvalerate lambda-cyhalothrin imidacloprid thiamethoxam thiacloprid	alphamethrin, cypermethrin, zeta-cypermethrin, deltamethrin, gamma-cyhalothrin, chlorpyrifos, chlorpyrifos-methy, tau-fluvalinate, paraffin oil, pirimicarb, dimethoate, esfenvalerate, flonicamid, lime sulphur, etofenprox	2% 15% 5% 15% 10% 10% 5%	−1% −1% −1% −1% −20% −20% −1%	5,84 5,84 5,84 5,84 116,80 116,80 5,84	
AELIA SPP., EURYGASTER SPP.	beta-cyfluthrin deltamethrin lambda-cyhalothrin thiamethoxam thiacloprid	alphamethrin, cypermethrin, chlorpyrifos, thiacloprid, beta-cyfluthrin, deltamethrin, lambda-cyhalothrin, chlorpyrifos-methyl	5% 2% 15% 10% 5%	−5% −5% −5% −20% −1%	29,20 29,20 29,20 116,80 5,84	
FUNGICIDES						
ERYSIPHE GRAMINIS	cyproconazole epoxiconazole propiconazole prothioconazole (+spiroxamine, tebuconazole) prothioconazole +tebuconazole prothioconazole (+trifloxystrobin) tebuconazole tetraconazole thiophanate-methyl triadimenol +tebuconazole (+spiroxamine) metconazole prochloraz	bordeaux mixture +sulphur, azoxystrobin, chlorothalonil, cyflufenamid, sulphur, pyriofenone	15% 25% 15% 20% 20% 20% 50% 5% 5% 10% 5% 15%	−20% −20% −20% −35% −35% −35% −35% −20% −35% −35% −20% −20%	116,80 116,80 116,80 204,40 204,40 204,40 204,40 116,80 204,40 204,40 116,80 116,80	
PUCCINIA SPP.	cyproconazole epoxiconazole propiconazole prothioconazole (+spiroxamine, tebuconazole) prothioconazole (+trifloxystrobin) tebuconazole tetraconazole thiophanate-methyl triadimenol +tebuconazole (+spiroxamine) metconazole	pyraclostrobin, azoxystrobin, chlorothalonil	15% 25% 15% 20% 20% 50% 5% 5% 10% 5%	−20% −20% −20% −35% −25% −35% −20% −35% −35% −20%	116,80 116,80 116,80 204,40 146,00 204,40 116,80 204,40 204,40 116,80	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
SEPTORIA TRITICI	cyproconazole difenoconazole epoxiconazole propiconazole prothioconazole (+spiroxamine, tebuconazole) prothioconazole (+trifloxystrobin) tebuconazole tetraconazole thiophanate-methyl triadimenol +tebuconazole (+spiroxamine) triticonazole metconazole	azoxystrobin, fludioxonil, Pythium oligandrum, chlorothalonil	15% 1% 25% 15% 20% 20% 50% 5% 5% 10% 1% 5%	−20% −15% −20% −20% −35% −25% −35% −20% −35% −35% −15% −20%	116,80 87,60 116,80 116,80 204,40 146,00 204,40 116,80 204,40 204,40 87,60 116,80	
FUSARIUM SPP.	difenoconazole epoxiconazole prothioconazole prothioconazole +tebuconazole tebuconazole tetraconazole thiophanate-methyl triadimenol +tebuconazole (+spiroxamine) triticonazole metconazole	fludioxonil, Pythium oligandrum, chlorothalonil	1% 25% 20% 20% 50% 5% 5% 10% 5%	−25% −20% −25% −35% −35% −20% −35% −35% −15% −20%	146,00 116,80 146,00 204,40 204,40 116,80 204,40 204,40 87,60 116,80	
TILLETIA SPP.	difenoconazole prothioconazole +tebuconazole thiram triticonazole	fludioxonil	1% 20% 1% 1%	−25% −35% −25% −15%	146,00 204,40 146,00 87,60	
HELMINTHOSPORIUM SPP.	difenoconazole propiconazole prothioconazole (+piroxamine, tebuconazole) tebuconazole thiophanate-methyl triticonazole metconazole prochloraz	bordeaux mixture +sulphur, pyraclostrobin, fludioxonil, Pythium oligandrum, chlorothalonil	1% 15% 20% 50% 5% 1% 5% 15%	−15% −20% −35% −35% −35% −15% −20% −20%	87,60 116,80 204,40 204,40 204,40 87,60 116,80 116,80	
ALTERNARIA ALTERNATA	prothioconazole +tebuconazole triticonazole	azoxystrobin, chlorothalonil	20% 1%	−35% −25%	204,40 146,00	100 100
HERBICIDES						
DICOT HERBS FROM SEED	flumioxazin	metsulphuron-methyl, dicamba, sulphosulphuron,	1%	−1%	5,84	
MONOCOT AND DICOT HERBS	glyphosate	diquat (dibromide)	10%	−20%	116,80	100
APERA SPICA VENTI, DICOT HERBS FROM SEED	metribuzin (+flufenacet)	dicamba, MCPA	1%	−1%	5,84	100
MONOCOT AND DICOT HERBS FROM SEED	pendimethalin pinoxaden (+florasulam, cloquintocet-mexyl) chlorotoluron	sulphosulphuron, iodosulphuron +mefenpyr-diethyl +mesosulphuron, florasulam +cloquintocet-mexyl +pinoxaden, iodosulphuron +mefenpyr-diethyl +mesosulphuron, mefenpyr-diethyl +propoxycarbazone, sulphosulphuron, bifenox +mecoprop, prosulphocarb	2% 2% 2%	−1% −1% −1%	5,84 5,84 5,84	
DICOT HERBS	clopyralid	dicamba, 2,4-D, MCPA	5%	−1%	5,84	
DICOT HERBS FROM SEED, CONVOLVULUS ARVENSIS, CALYSTEGIA SEPIUM, RUBUS	fluroxypir	dicamba, 2,4-D, MCPA	25%	−1%	5,84	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
MAIZE				**−2%**	**19,08**	
INSECTICIDES						
DIABROTICA VIRGIFERA VIRGIFERA	beta-cyfluthrin lambda-cyhalothrin thiacloprid	acetamiprid, cypermethrin, indoxacarb, chlorpyrifos, Heterorhabditis bacteriophora, teflutrin, zeta-cypermethrin	2% 2% 2%			
HELICOVERPA ARMIGERA	beta-cyfluthrin lambda-cyhalothrin	indoxacarb, (E,Z)-3,8,11-tetradecatrienil-acetate +(E,Z)-3,8-tetradecadineil-acetate +(Z)-11-hexadecanal +(Z)-9-hexadecanal +hexadecan-1-ol + hexadecanal, cypermethrin, Bacillus thuringiensis ssp. kurstaki, indoxacarb, chlorantraniliprole, methoxyfenozide, trichogramma evanescens +trichogramma pintoi, trichogramma evanescens, trichogramma pintoi	2% 2%			
OSTRINIA NUBILALIS	beta-cyfluthrin deltamethrin esfenvalerate lambda-cyhalothrin	alphamethrin, Bacillus thuringiensis ssp. kurstaki, cypermethrin, indoxacarb, chlorantraniliprole, methoxyfenozide, trichogramma evanescens +trichogramma pintoi, zeta-cypermethrin	2% 2% 2% 2%			
FUNGICIDES						
HELMINTHOSPORIUM SPP.	propiconazole (+azoxystrobin) prothioconazole (+fluopyram)	pyraclostrobin	2% 2%	−5% −5%	42,60 42,60	100 100
FUSARIUM SPP.	prothioconazole	Pythium oligandrum	2%	−5%	42,60	
GERMICIDAL DISEASES				−5%	42,60	
HERBICIDES						
DESICCATION	glyphosate	diquat (dibromide)	10%	−20%	170,40	100
DICOT HERBS	clopyralid picloram +clopyralid	2,4-D, dicamba, nicosulphuron 2,4-D, dicamba, nicosulphuron	5% 5%			
DICOT HERBS FROM SEED, CONVOLVULUS ARVENSIS, CALYSTEGIA SEPIUM, RUBUS	fluroxypir	2,4-D, dicamba, nicosulphuron	2%			
DICOT HERBS FROM SEED	flumioxazine linuron		2% 2%	−4%	34,08	
MONOCOT HERBS FROM SEED	dimethenamid-P S-metolachlor		5% 15%			
MONOCOT AND DICOT HERBS FROM SEED	Monocot and dicot herbs from seed Monocot and dicot herbs from seed		5% 30%			

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
SUNFLOWER				**−9%**	**58**	
		INSECTICIDES				
APHIDS	thiamethoxam deltamethrin lambda-cyhalothrin thiacloprid	thiacloprid, chlorpyrifos, deltamethrin, lambda-cyhalothrin, tau-fluvalinate, pirimicarb, gamma-cyhalothrin	10% 2% 5% 1%	−20%	126,40	
MIRIDAE	deltamethrin lambda−cyhalothrin	gamma−cyhalothrin	2% 5%	−10% −10%	63,20 63,20	100 100
		FUNGICIDES				
DIAPORTHE HELIANTHI	prothioconazole (+fluopyram) iprodione prochloraz difenoconazole (+azoxystrobin) cyproconazole (+azoxystrobin)	bordeaux mixture +sulphur, dimoxystrobin +boscalid, pyraclostrobin, Pythium oligandrum	1% 1% 10% 1% 15%	−1% −5%	6,32 31,60	
SCLEROTINIA SCLEROTIORUM	prothioconazole (+fluopyram) difenoconazole (+azoxystrobin) cyproconazole (+azoxystrobin)	dimoxystrobin +boscalid, pyraclostrobin, fludioxonil, Pythium oligandrum	1% 1% 15%	−5%	31,60	
BOTRYTIS CINEREA	prothioconazole (+fluopyram) cyproconazole (+azoxystrobin)	dimoxystrobin +boscalid, fludioxonil, Pythium oligandrum	1% 15%	0% −5%	31,60	
PHOMA MACDONALDII	prothioconazole (+fluopyram) difenoconazole (+azoxystrobin) cyproconazole (+azoxystrobin)	bordeaux mixture +sulphur, dimoxystrobin +boscalid, pyraclostrobin, Pythium oligandrum	1% 1% 15%	−5%	31,60	
ALTERNARIA SPP.	prothioconazole (+fluopyram) iprodione prochloraz cyproconazole (+azoxystrobin) difenoconazole (+azoxystrobin)	bordeaux mixture +sulphur, dimoxystrobin +boscalid, pyraclostrobin, fludioxonil, Pythium oligandrum	1% 1% 10% 15% 1%	−1% −5%	6,32 31,60	
GERMICIDAL DISEASES	thiram		1%			
		HERBICIDES				
DICOT HERBS FROM SEED	flumioxazine linuron	flurochloridone, imazamox, benfluralin, prosulphocarb	2% 2%	−30% −10%	189,60 63,20	
DESICCATION	glyphosate	diquat (dibromide), bromoxynil	10%	−20%	126,40	100
MONOCOT HERBS FROM SEED	S-metolachlor dimethenamid-P	imazamox, quizalofop-p-ethyl, benfluralin, prosulphocarb, clethodim	25% 20%	−10% −10%	63,20 63,20	
MONOCOT HERBS FROM SEED, SORGHUM HALEPENSE, ELYMUS REPENS	fluazifop−P butyl	imazamox, quizalofop-p-ethyl, clethodim"	2%	−30%	189,60	
MONOCOT AND DICOT HERBS FROM SEED	pendimethalin terbuthylazine +S−metolachlor	imazamox, benfluralin, prosulphocarb	20% 15%	−10% −10%	63,20 63,20	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
GRAPES				**−66%**	**1,125**	
		INSECTICIDES				
GRAPEVINE PHYLLOXERA	spirotetramat thiamethoxam	dazomet; metomil; teflutrin	10% 70%	100% −50%	−1.704,00 852,00	
GRAPEVINE MOTHS	thiamethoxam beta-cyfluthrin deltamethrin esfenvalerate lambda-cyhalothrin spinozad	alphamethrin; Bacillus thuringiensis ssp. kurstaki; chlorpyrifos; chlorantraniliprole; cypermethrin; emamectine benzoate; fenoxycarb; indoxakarb; methoxyfenozide; tau-fluvalinate	70% 40% 40% 30% 30% 20%	−50% −10% −5% −3% −3% −5%	852,00 170,40 85,20 51,12 51,12 85,20	
GRAPEVINE ACARI	abamectin		20%	−1%	17,04	
SCAPHOIDEUS TITANUS	beta−cylfuthrin deltamethrin lambda−cyhalothrin spinozad thiamethoxam spirotetramat thiamethoxam	alphamethrin; chlorpyrifos; chlorpyrifos, cypermethrin; chlorpyrifos-methyl; tau-fluvalinate	10% 20% 60% 2% 85% 10% 85%	−1% −10% −60% −2% −85% −5% −75%	17,04 170,40 1.022,40 34,08 1.448,40 85,20 1.278,00	
		FUNGICIDES				
PLASMOPARA VITICOLA	Cu +mancozeb Cu-oxychloride + mancozeb Folpet mancozeb metiram thiram benalaxyl-M +folpet benalaxyl-M +mancozeb mefenoxam +mancozeb benthiavalicarb-isopropyl + mancozeb benthiavalicarb-isopropyl + folpet dimethomorph + folpet dimethomorph + mancozeb mandipropamid mandipropamid +folpet mandipropamid +mancozeb mandipropamid +Cu-oxychloride valifeanal +folpet valifeanal +mankoceb azoxystrobin +folpet pyraclostrobin + metiram trilfoxystrobin + tebuconazole famoxadon + mancozeb ametoctradin + metiram cyazofamid + folpet cymoxanil + folpet cymoxanil + mancozeb fluazinam	cupriferous substances propineb dimethomorph + Cu-oxychloride; iprovalicarb +Cu oxychloride azoxystrobin; kresoxim-methyl + boscalid; famoxadone + cymoxanil	- - 80% 100% 85% 15% 20% 20% 20% 30% 35% 25% 25% 25% 40% 40% 50% 30% 30% 20% 50% 50% 30% 50% 40% 50% 30% 25%	0% 0% −30% −30% −30% −10% −10% −10% −10% −10% −10% −10% −10% −10% −15% −15% −20% −15% −10% −5% −15% −10% −10% −15% −10% −15% −5% −10%	- - 511,20 511,20 511,20 170,40 170,40 170,40 170,40 170,40 170,40 170,40 170,40 170,40 255,60 255,60 340,80 255,60 170,40 85,20 255,60 170,40 170,40 255,60 170,40 255,60 85,20 170,40	0 0 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100 100
UNCINULA NECATOR (POLDERY MILDEW)	difenoconazole + cyflufenamid myclobutanil myclobutanil + quinoxyfen propiconazole penconazole tebuconazole tebuconazole + tridiamenol + spiroxamin tetraconazole tetraconazole proquinazid triadimenol + folpet fluopyram + tebuconazole thiophanate-methyl	sulphur; fluxapyroxad; fluopyram; metrafenone; pyriofenon; cyflufenamid; meptildinocap	95% 50% 50% 30% 20% 70% 80% 70% 60% 50% 30% 15%	−45% −15% −15% −10% −5% −30% −40% −30% −35% −15% −15% −2%	766,80 255,60 255,60 170,40 85,20 511,20 681,60 511,20 596,40 255,60 255,60 34,08	100

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
BOTRYTIS CYNEREA	iprodione	cyprodinil; cyprodinil + fludioxonil; pirimetanil; fenhexamid; fenpirizamin; boscalid; Aureobasidium pullulans	30%	−3%	51,12	
HERBICIDES						
MONOCOT AND DICOT HERBS FROM SEED	glyphosinate-ammonium linuron terbuthylazinependime-thalin	flazasulphuron; napropamid		−2% −2% −2% −2%		
MONOCOT HERBS	fluazifop-p-butyl	propaquizafop; quizalofop-p-ethyl; quizalofop-p-tefuryl		−2%		
MONOCOT HERBS FROM SEED	S−metolachlor			−2%		
DICOT HERBS FROM SEED	flumioxazine terbuthylazine	oxyfluorfen		−2% −2%		
MONOCOT AND DICOT HERBS	glyphosate	diquat−dibrimid		−2%		
OSR				**−8%**	**50.77**	
INSECTICIDES						
ATHALIA ROSAE	beta-cyfluthrin deltamethrin esfenvalerate lambda-cyhalothrin	acetamiprid, cypermethrin, chlorpyrifos, alphamethrin, tau-flavulinate, cyantraniliprole, gamma-cyhalothrin, chlorpyrifos-methyl	2% 2%	-5% −5%	33,60 33,60	
PSYLLIODES CHRYSOCEPHALA	beta-cyfluthrin deltamethrin	acetamiprid, cypermethrin, chlorpyrifos, alphamethrin, tau-flavulinate, cyantraniliprole, gamma-cyhalothrin, chlorpyrifos-methyl	2% 2%	−5% −5%	33,60 33,60	
PHYLLOTRETA SPP.	beta-cyfluthrin deltamethrin	acetamiprid, chlorpyrifos, cyantraniliprole, gamma-cyhalothrin	2% 2%	−5% −5%	33,60 33,60	
CEUTORHYNCHUS PALLIDACTYLUS	beta−cyfluthrin deltamethrin lambda-cyhalothrin thiacloprid	acetamiprid, cypermethrin, chlorpyrifos, alphamethrin, tau-flavulinate, gamma-cyhalothrin, chlorpyrifos-methyl, thiacloprid, zeta-cypermethrin, etofenprox	2% 2% 2% 15%	−5% −5% −5% −5%	33,60 33,60 33,60 33,60	
CEUTORHYNCHUS OBSTRICTUS	beta-cyfluthrin deltamethrin esfenvalerate thiacloprid lambda-cyhalothrin	acetamiprid, cypermethrin, chlorpyrifos, alphamethrin, tau-flavulinate, gamma-cyhalothrin, chlorpyrifos-methyl, thiacloprid, zeta-cypermethrin, etofenprox	2% 2% 2% 15% 2%	−5% −5% −5% −5% −5%	33,60 33,60 33,60 33,60 33,60	
CEUTORHYNCHUS NAPI	deltamethrin thiacloprid	thiacloprid, etofenprox	15% 15%	−5% −5%	33,60 33,60	 100
MELIGETHES AENEUS	beta−cyfluthrin deltamethrin lambda−cyhalothrin thiacloprid	acetamiprid, cypermethrin, chlorpyrifos, alphamethrin, tau-flavulinate, gamma-cyhalothrin, chlorpyrifos-methyl, pymetrozine,thiacloprid, zeta-cypermethrin, etofenprox, phosmet, indoxacarb, pymetrozine	2% 2% 2% 15%	−5% −5% −5% −5%	33,60 33,60 33,60 33,60	
APHIDS	deltamethrin lambda-cyhalothrin	acetamiprid, alphamethrin, cypermethrin, gamma-cyhalothrin, chlorpyrifos, chlorpyrifos-methyl, lambda-cyhalothrin, pymetrozine, tau-flavulinate, thiacloprid	2% 2%	−5% −5%	33,60 33,60	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
FUNGICIDES						
ALTERNARIA BRASSICAE	difenoconazole prothioconazole (+fluopyram) prothioconazole +tebuconazole tetraconazole (+chlorothalonil) metconazole cyproconazole (+azoxystrobin)	dimoxystrobin +boscalid, boscalid, azoxystrobin, Pythium oligandrum	2% 2% 2% 2% 2% 2%	−5% −5% −5% −5% −5% −5%	33,60 33,60 33,60 33,60 33,60 33,60	
PHOMA LINGAM	difenoconazole prothioconazole (+fluopyram) prothioconazole +tebuconazole tebuconazole tetraconazole (+chlorothalonil) thiophanate-methyl cyproconazole (+azoxystrobin)	dimoxystrobin +boscalid, azoxystrobin, Pythium oligandrum	2% 2% 2% 2% 2% 2% 2%	−5% −5% −5% −5% −5% −5% −5%	33,60 33,60 33,60 33,60 33,60 33,60 33,60	
SCLEROTINIA SCLEROTIORUM	difenoconazole prothioconazole (+fluopyram) prothioconazole +tebuconazole tebuconazole tetraconazole (+chlorothalonil) thiophanate-methyl cyproconazole (+azoxystrobin)	dimoxystrobin +boscalid, boscalid, azoxystrobin, Pythium oligandrum	2% 2% 2% 2% 2% 2% 2%	−5% −5% −5% −5% −5% −5% −5%	33,60 33,60 33,60 33,60 33,60 33,60 33,60	
BOTRYTIS CINEREA	prothioconazole (+fluopyram) tetraconazole (+chlorothalonil)	dimoxystrobin +boscalid, boscalid, azoxystrobin, Pythium oligandrum	2% 2%	−5% −5%	33,60 33,60	
GERMICIDAL DISEASES	thiram	Pythium oligandrum	2%	−5%	33,60	
HERBICIDES						
DESICCATION	glyphosate	diquat (dibromide), bromoxynil	10%	−20%	134,40	100
DICOT HERBS	clopyralid picloram +clopyralid		5% 5%	−1% −1%	6,72 6,72	
VOLUNTEER GRAIN	fluazifop−P butyl	propyzamide, clethodim, quizalofop-P-ethyl	2%	−30%	201,60	
MONOCOT HERBS FROM SEED	S-metolachlor	clomazone, propyzamide, quizalofop-P-ethyl, dimethachlor, clethodim	25%	−10%	67,20	

APRICOTS				**−69%**	**2,983**	

ROMANIA

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
MAIZE				**−51%**	**30**	**73%**
APPLES				**−59%**	**205.6**	**53%**
INSECTICIDES						
LEAF MINERS, CODLING MOTH, MITES	bifenthrin	acetamiprid, chlorantraniliprole, esfenvaletate, etofenprox, fenoxycarb, thiacloprid, lambda-cyhalothrin, spinosad, thiamethoxam, chlorpyrifos +deltamethrin	100%	−20%	108	20%
APHIDS, WOOLLY APHIDS, WASPS, LEAF MINERS, CODLING MOTH	deltamethrin	acetamiprid, cypermethrin, chlorantraniliprole, etofenprox, lambda-cyhalothrin, spinosad, thiacloprid, tau-fluvalinate, thiamethoxam, chlorpyrifos +deltamethrin	100%	−35%	83	25%
WOOLLY APHIDS, WASPS, WEEVILS, LEAF MINERS, CODLING MOTH	dimethoate	-acetamiprid, cypermethrin, chlorantraniliprole, etofenprox, lambda-cyhalothrin, spinosad, thiacloprid, tau-fluvalinate, thiamethoxam	100%	−35%	83	25%
APHIDS, LEAF MINERS, CODLING MOTH	esfenvalerate	acetamiprid, cypermethrin, deltamethrin, dimethoate, chlorantraniliprole, etofenprox, lambda-cyhalothrin, spinosad, thiacloprid, tau-fluvalinate, thiamethoxam	100%	−25%	83	30%
SAN JOSE SCALES, APHIDS, WOOLLY APHIDS, WEEVILS, LEAF MINERS, PSYLLIDS	thiamethoxam	acetamiprid, cypermethrin, dimethoate, deltamethrin, etofenprox, lambda-cyhalothrin, thiacloprid, tau-fluvalinate, spinosad, spirotetramat	100%	−35%	83	25%
PSYLLIDAE, MITES	ED, abamectin	acetamiprid, beta-cyfluthrin, diflubenzuron, spirotetramat, spinosad, thiacloprid, thiamethoxam, lambda−cyhalothrin chlorpyrifos +deltamethrin	100%	−45%	162	40%
PSYLLIDAE, MITES, LEAF MINERS, DEFOLIATORS, CODLING MOTH	ED, beta-cyfluthrin	acetamiprid, abamectin, abamectin +chlorantra-niliprol, diflubenzuron, spirotetramat, spinosad, thiacloprid, thiamethox-am, lambda-cyhalothrin, chlorpyrifos +deltamethrin,	100%	−20%	162	15%
APHIDS, WASPS, LEAF MINERS, CODLING MOTH, PSYLLIDS	ED, lambda-cyhalothrin	acetamiprid, cypermethrin, chlorantraniliprole, etofenprox, esfenvalerate, spinosad, thiacloprid, tau-fluvalinate, thiamethoxam, chlorpyrifos +deltamethrin	100%	−35%	83	25%
LEAF MINERS, CODLING MOTH, PSYLLIDS	ED, spinosad	acetamiprid, diflubenzuron, thiacloprid, imidacloprid, thiamethoxam	100%	-35%	92	10%
WOOLLY APHIDS, SAN JOSE SCALE AND PSYLLIDS	ED, spirotetramat	acetamiprid, diflubenzuron, thiacloprid imidacloprid, thiamethoxam	100%	−35%	92	10%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
FUNGICIDES						
SCAB, STORAGE DISEASES	captan	copper hydroxide, copper oxychlorur, chlorotalonil, dithianon, pyrimethanil	100%	-18%	41	15%
SCAB, STORAGE DISEASES	folpan	copper hydroxide, copper oxychlorur, chlorotalonil, dithianon	100%	-18%	41	15%
SCAB, POWDERY MILDEW, STORAGE DISEASES	iprodione	captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole	100%	−20%	29	10%
SCAB,	metiram	captan, folpan, chlorotalonil, dithianon, propineb, pyrimethanil	100%	−20%	29	20%
SCAB, POWDERY MILDEW	myclobutanyl	penthiopyrad, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	29	15%
SCAB, POWDERY MILDEW	difenoconazole	cyprodinil, penthiopyrad, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	29	20%
SCAB	fenbuconazole	cyprodinil, penthiopyrad, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole	100%	−20%	29	10%
SCAB, POWDERY MILDEW, STORAGE DISEASES	fluquiconazole +pyrimethanil	cyprodinil, penthiopyrad captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	80%	−20%	29	10%
POWDERY MILDEW	penconazole	sulphur, cyprodinil, kresoxim-methyl, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	17	20%
POWDERY MILDEW	propiconazole	sulphur, cyprodinil, kresoxim-methyl, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	17	10%
SCAB, POWDERY MILDEW	triadimenol	cyprodinil, penthiopyrad captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	29	20%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
SCAB, STORAGE DISEASES	ED, mancozeb	chlorotalonil, dithianon, propineb, pyrimethanil	100%	−15%	15	25%
SCAB, POWDERY MILDEW	ED, tebuconazole +fluopyram	cyprodinil, penthiopyrad, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole,isopyrazam +difenoconazole	100%	−20%	29	20%
SCAB, POWDERY MILDEW, STORAGE DISEASES	ED, thiophanate methyl	cyprodinil, penthiopyrad, tebuconazole, captan +trifloxystrobin, boscalid +pyraclostrobin, cyprodinil +fludioxonil, dithianon +pyraclostrobin, fluopyram +tebuconazole, isopyrazam +difenoconazole	100%	−20%	29	20%
HERBICIDES						
DICOTS WEEDS	fluroxypyr	cycloxidim, oxyfluorfen, glyphosate, glyphosate +flazasulphuron, quizalofop-P-ethyl	100%	10%	72	10%
MONOCOTS AND MANY DICOTS POST-EMERGENT	glyphosate	cycloxidim, fluoxypyr, oxyfluorfen, glyphosate +flazasulphuron, quizalofop-P-ethyl	100%	10%	72	10%
DICOTS WEEDS	ED, pendimethalin	cycloxidim, fluroxypyr, fluasifop-P-butyl, glyphosate, glyphosate +flazasulphuron, quizalofop-p-ethyl	100%	10%	72	20%
MONOCOTS WEEDS	ED, fluasifop-p-butyl	cycloxidim, fluroxypir, glyphosate, glyphosate +flazasulphuron, pendimethalin, quizalofop-p-ethyl	100%	10%	72	15%
MONO- AND DICOTS WEEDS	ED, glyphosinate-ammonium	cycloxidim, fluroxypir, oxyfluorfen, glyphosate, glyphosate +flazasulphuron, quizalofop-p-ethyl	100%	10%	72	15%
NEONICOTINOIDS						
SAN JOSE SCALES, MITES, MITES (WINTER FORMS)	acetamiprid	spirodiclofen, spirotetramate, thiamethoxam, chlorpyrifos +deltamethrin	100%	−25%	108	20%
SAN JOSE SCALES, MITES, MITES (WINTER FORMS)	imidacloprid	acetamiprid +rapeseed oil spirodiclofen, spirotetramate, thiamethoxam, chlorpyrifos +deltamethrin	100%	−25%	131	30%
SAN JOSE SCALES, APHIDS, WEEVILS, WASPS, LEAF MINERS, CODLING MOTH	thiacloprid	acetamiprid, chlorantraniliprole, esfenvaletate, etofnprox, fenoxycarb, thiacloprid, lambda-cyhalothrin, spinosad, thiamethoxam, chlorpyrifos +deltamethrin	100%	-20%	108	20%

POTATOES				**−18%**	**250**	**65%**

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ ha)	Additional resistance (Δ %)
GRAPES				**–46%**	**300**	**10%**
		INSECTICIDES				
MITES	Abamectin	Spirodiclofen				
MILBEMECTIN						
HEXITHIAZOX	100%	5%	100			
GRAPEVINE MOTH	Abamectin	Indoxicarb, Chlorantaniliprole, Methoxyfenozide, Alpha-cypermethrin, Emamectin-benzoate	100%	15%	100	
GRAPEVINE MOTH	Deltamethrin	Indoxicarb, Chlorantaniliprol, Methoxyfenozide, Acetamiprid, Alpha-cypermethrin, Emamectin-benzoate	100%	15%	100	
GRAPEVINE MOTH	Dimethoate	Indoxicarb, Chlorantaniliprol, Methoxyfenozide, Acetamiprid, Alpha-cypermethrin, Emamectin-benzoate	100%	15%	100	
GRAPEVINE MOTH	Esfenvalerat	Indoxicarb, Chlorantaniliprol, Methoxyfenozide, Acetamiprid, Alpha-cypermethrin, Emamectin-benzoate	100%	15%	100	
		FUNGICIDES				
GRAPE WINE MILDEW	Captan	Propineb	100%	20%	100	
GRAPE WINE MILDEW	Folpet	Chlorothalonil	100%	20%	100	
GRAPE WINE MILDEW	Mancozeb	Metalaxil	100%	20%	100	
GRAPE WINE MILDEW	Mandipropamid	Iprovalicarb	100%	20%	100	
GRAPE WINE MILDEW	Metiram	Fosetyl Al.	100%	20%	100	
POWDERY MILDEW	Dinocap	Oxychlorur Cupru	100%	25%	100	10%
POWDERY MILDEW	Difenoconazole	Hydroxide Cupru	100%	25%	100	10%
POWDERY MILDEW	Penconazole	Cyazofamid	100%	25%	100	10%
POWDERY MILDEW	Tebuconazole	"	100%	25%	100	10%
BOTRYTIS ROT	Tetraconazole	Chlorothalonil	100%	-	100	10%
		HERBICIDES				
	Glyphosate	Flazasulphuron Flazifop-p-butyl Propaquizafop	100%	10%	100	
TOMATOES (OPEN FIELD)				**–20%**	**400**	**–10%**

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
OSR				−30%	12	0%
INSECTICIDES						
	Deltamethrin		100%			
	imidacloprid		100%	0%	0	0
	Lambda-cyhalothrin		100%	0%	0	0
FUNGICIDES						
	cyproconazole, difenoconazole, epoxiconazole, iprodione, metconazole, prochloraz, propiconazole, prothioconazole, tebuconazole, tetraconazole, thiophanate-methyl	3 molecules for foliar treatments (azoxystrobin, boscalid; dimoxystrobin, flutriafol) and one molecule for seed treatment (thiuram)	100%	30%		
HERBICIDES						
	Aminopyralid and clopyralid and picloram, clopyralid and picloram, clopyralid	etametsulphuron methyl, imazamox and metazachlor, imazamox and quinmerac	100%	0%	12	0
	Dimethenamid-p and metazaclor and quinmerac		25%	0%		0
	Glyphosate		100%	0%	0	0
	Fluazifop-p-butyl	quizalofop-p-tefuryl, 8 products using quizalofop-p-ethyl, haloxifop-p, cletodim, propaquizafop	0%	0%		0
	S-metolachlor	Dimethachlor, 4 products using clomazone	0%	0%		0

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
WHEAT				−33%	79	23%
INSECTICIDES						
AGRIOTES SPP., MACROSIPHUM AVENAE, RHAPALOSIPHUM, METOPOLOPHIUM DIRHODUM, SCHIZAPHIS GRAMINUM, ZABRUS TENEBRIOIDES	Thiamethoxam	imidacloprid, thiacloprid	42%	11%	70	20%
AFIDE (MACROSIPHUM AVENAE, RHAPALOSIPHUM, METOPOLOPHIUM DIRHODUM, SCHIZAPHIS GRAMINUM)	Imidacloprid	thiamethoxam, thiacloprid	44%	13%	90	20%
VIERMI SARMA (AGRIOTES SPP.)	Cypermethrin	imidacloprid, thiacloprid, thiamethoxam	25%	11%	45	15%
DAUNATORI DEPOZITE, PLOSNITA CEREALELOR	Pirimifos methyl	deltamethrin, cypermethrin	35%	22%	80	4%
PLOSNITA GRAULUI, GANDACUL BALOS	Thiacloprid	imidacloprid, thiamethoxam, thiacloprid, deltamethrin, cypermethrin	46%	30%	95	7%
PLOSNITA CEREALELOR, GANDACUL BALOS	Deltamethrin	cypermethrin, alpha-cypermethrin, lambda-cyhalothrin, acetamiprid, esfenvalerat, gamma-cyhalothrin	46%	30%	70	8%
AFIDE, GANDACUL BALOS	Alpha-cypermethrin	cypermethrin, alpha-cypermethrin, lambda-cyhalothrin, esfenvalerat, gamma-cyhalothrin, thiamethoxam	46%	30%	65	9%
PLOSNITA CEREALELOR, GANDACUL BALOS	Lambda-cyhalothrin	cypermethrin, alpha-cypermethrin, esfenvalerat, gamma-cyhalothrin	46%	29%	51	5%
PLOSNITA CEREALELOR	Acetamiprid	cypermethrin, alpha-cypermethrin, lambda-cyhalothrin, esfenvalerate, gamma-cyhalothrin, thiamethoxam	44%	22%	59	5%
PLOSNITA CEREALELOR	Dimethoate	thiamethoxam, alpha-cypermethrin, esfenvalerate	28%	15%	35	16%
PLOSNITA CEREALELOR	Chlorpyrifos methyl	deltamethrin, cypermethrin	44%	20%	65	8%
EURYGASTER INTEGRICEPS, LEMA MELANOPA	Esfenvalerate	deltametrin, cypermethrin, alpha-cypermethrin, esfenvalerate, gamma-cyhalothrin	54%	25%	42	6%
PLOSNITA CEREALELOR, GANDACUL BALOS	Gamma-cyhalothrin	deltamethrin, cypermethrin, alpha-cypermethrin, esfenvalerate	47%	30%	52	10%
FUNGICIDES						
FUSARIUM SPP., TILLETIA SPP., USTILAGO NUDA, PYRENOPHORA GRAMINEA	Tebuconazole	prochloraz, cyproconazole, propiconazol, carboxin, picoxystrobin, azoxystrobin, chlorotalonil	85%	35%	55	20%
TILLETIA SPP., FUSARIUM SPP., PYRENOPHORA GRAMINEA	Prochloraz	tebuconazole, cyproconazole, propiconazole, carboxin, picoxistrobin, azoxystrobin, chlorotalonil	85%	35%	55	20%
TILLETIA SPP., FUSARIUM SPP., TILLETIA CONTROVERSA, PYRENOPHORA GRAMINEA	Cyproconazol	strobilurin, prochloraz, propiconazol, difenoconazole, carboxin	70%	28%	60	22%
TILLETIA SPP., FUSARIUM SPP., FUSARIUM NIVALE	Difenoconazol	carboxin, strobilurin, tebuconazole, chlorotalonil, metconazole	65%	30%	40	15%
TILLETIA SPP., FUSARIUM SPP., PYRENOPHORA GRAMINEA, USTILAGO NUDA, MICRODOCHIUM NIVALE	Protioconazol	prochloraz, cyproconazol, carboxin, azoxystrobin, chlorotalonil, propiconazole	88%	25%	65	17%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
TILLETIA SPP.	Thiram	carboxin	15%	8%	2	0%
TILLETIA SPP., FUSARIUM SPP.	Carboxin	thiram, strobilurin, metconazol, chlorotalonil	41%	16%	45	8%
COMPLEX BOLI FOLIARE	Picoxystrobin	prochloraz, cyproconazole, chlorotalonil, propiconazole, azoxystrobin	80%	21%	60	9%
BOLI FOLIARE	Kresoxim-methyl	methyl thiophanate, epoxiconazole, cymoxanil, prochloraz, strobilurin	85%	30%	45	4%
BOLI FOLIARE	Epoxiconazole	methyl thiophanate, prochloraz, propiconazole, strobilurin	85%	30%	65	12%
BOLI FOLIARE SI ALE SPICULUI	Azoxystrobin	tebuconazole, cyproconazole, fludioxonil, difenoconazole, prochloraz, triticonazole, prothioconazole	90%	25%	75	15%
BOLI FOLIARE SI ALE SPICULUI	Chlorotalonil	tebuconazole, cyproconazole, fludioxonil, difenoconazole, prochloraz, triticonazole, protioconazole	90%	27%	60	8%
BOLI FOLIARE, INCLUSIV DE VARA	Metconazole	propiconazol, strobiruline, methyl thiophanate, chlorotalonil, azoxystrobin	65%	20%	65	14%
BOLI FOLIARE, INCLUSIV DE VARA	Mepiquat chlorur	0	50%	15%	35	25%
FAINARE + ALTE BOLI FOLIARE	Cyflufenamid	metconazol, prochloraz, chlorotalonil, azoxystrobin, cyproconazol	75%	15%	45	14%
FAINARE + ALTE BOLI FOLIARE	Thiophanate-methyl	triadimenol, protioconazole	60%	10%	15	25%
BOLI FOLIARE	Proquinazid	prochloraz, tebuconazole, trifloxystrobin, protioconazole, epoxiconazole	90%	18%	65	4%
BOLI FOLIARE + SPIC (FUSARIUM)	Triadimenol	proquinazid, tebuconazole, epoxiconazole, triadimenol, cyproconazole, prochloraz	90%	20%	60	5%
BOLI FOLIARE + SPIC (FUSARIUM)	Spiroxamina	prochloraz, epoxiconazole, propiconazole, cyproconazole	90%	25%	70	12%
MILDEW, SEPTORIA, RUGINI, FUSARIUM SPP.	Trifloxystrobin	azoxystrobin, chlorotalonil, triadimenol, spiroxamina	95%	18%	90	6%
BOLI FOLIARE	Fenpropimorph	tebuconazole, azoxystrobin, epoxiconazole	90%	15%	49	7%
HERBICIDES						
ANNUAL AND PERENS MONOCOTS AND DICOTS	Glyphosate	nu are - singur pe domeniu	0%	30%	–10	NU
ANNUAL AND PERENS DICOTS	2,4 D din sare de dimethylamina	bromoxynil + 2,4D, dicamba + 2,4D, florasulam	85%	8%	15	15%
SPECTRU LARG DE DICOTILEDONATE, INCLUSIV EFEMERE	Metsulphuron-methyl	fluroxypir, florasulam, pendimethalin, tribenuron-methyl	89%	15%	45	
SPECIAL ANTI- GRAMINICIDE	Pyroxsulam	nu are - singur pe domeniu	35%	8%	40	
DICOTILE ANUALE SI PERENE	Florasulam	fluroxypir, dicamba, pendimethalin, metsulphuron-methyl	90%	14%	60	
DICOTILE ANUALE SI PARTIAL PERENE	Bromoxynil	dicamba, fluroxypir, metsulphuron-methyl, 2,4D	45%	3%	11	17%
DICOTILE SI MONOCOTILE PARTIAL PERENE	Pendimethalin	fluroxypir, dicamba, metsulphuron-methyl, 2,4D	60%	14%	14	
DICOTILE IN PREEMERGENTA	Tribenuron-methyl	metsuphuron-methyl, fluroxypir, dicamba	65%	15%	5	
DICOTILE IN PREEMERGENTA	Chlortoluron	in retragere	60%	0%	0	

SWEDEN

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
OSR				−21%	5.5	
INSECTICIDES						
INSECTS IN AUTUMN	Pyrethroids	None	55%	10%	10	no
SUMMER INSECTS (POLLEN BEETLE, WEEVILS, POD MIDGE)	Pyre, Thiacloprid	Indoxacarb, acetamiprid, tau-fluvalinate	80%	10%		70%
FUNGICIDES						
FUNGICIDE, SCLEROTINIA, PHOMA LINGAM	Prothioconazole	Azoxystrobin	30%	5%		
FUNGICIDE, EARLY, PGR	Tebuconazole	None	30%	5%		
SEED TREATMENT	Thiram	None	90%	0%		
HERBICIDES						
WEED CONTROL	Clopyralid, Picloram	Napropramide, Clomazone, Propyzamide, row cleaning	90%	5%	0	
DESICCATION	Glyphosate	Swathing, direct cut	5%	3%		
WHEAT				-27%	283.7	
INSECTICIDES						
VARIOUS INSECTS EXCEPT APHIDS	pyrethroids	none	40%	5%	52	0%
FUNGICIDES						
SEPTORIA, DRECHSLERA	triazoles (prothioconazole, propiconazole, difenoconazole, tebuconazole)	succinate dehydrogenase inhibitors	90%	20%	210	100%
TILLETSIA CONTROVERSA	difenoconazole	none	40%	3%	31	
RUST	difenoconazole	strobilurins	10%	5%	52	10%
MICRODOCHIUM, FUSARIUM, A.O. FUNGI CAUSING OUTWINTERING	thiophanatemethyl	none	10%	5%	52	0%
HERBICIDES						
DICOTE WEEDS	fluroxypyr, florasulam, clopyralid	fenoxy acids, sulphonyl–ureas ao	70%	7%	73	30%

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
RYE/TRITICALE				**−10%**	**104.5**	
		FUNGICIDES				
RUST	triazoles (prothioconazole, propiconazole, difenokonazole, tebuconazole)	strobilurins	30%	10%	105	10%
MICRODOCHIUM, FUSARIUM, A.O. FUNGI CAUSING OUTWINTERING	thiophanatemethyl	none	30%	7%	73	0%
		HERBICIDES				
DICOTE WEEDS	fluroxypyr, florasulam, clopyralid	fenoxy acids, sulphonyl–ureas ao	70%	7%	73	30%
MALTING BARLEY				**−6%**	**67.2**	
		INSECTICIDES				
VARIOUS INSECTS EXCEPT APHIDS	pyrethroids	none	10%	3%	34	
		FUNGICIDES				
DRESCHSLERA, RHYNCHOSPORIUM, RAMULARIA	triazoles (prothioconazole, propiconazole, difenokonazole, tebuconazole)	strobilurins	50%	5%	57	60%
SMUT	tebuconazole	none	20%	3%	34	0%
		HERBICIDES				
DICOTE WEEDS	fluroxypyr, florasulam, clopyralid	phenoxy acids, sulphonyl-ureas ao	50%	5%	57	20%
APPLES				**−29%**	**192.5**	
		INSECTICIDES				
INSECT	Thiacloprid		60%	10%	100	
INSECT	Spirotetramat		60%	10%	100	
		FUNGICIDES				
MILDEW	Penconazol		40%	15%	50	
STORAGE DISEASES	Thiophanate-methyl		25%	10%	50	
		HERBICIDES				
WEED	Glyphosate		80%	10%	50	
STRAWBERRY				**−27%**	**75**	
		INSECTICIDES				
INSECT INDOOR	Abamecthin		10%	20%	50	
INSECT OUTDOOR	Thiacloprid		60%	20%	50	
INSECT OUTDOOR	Spirotetramat		80%	20%	50	
		FUNGICIDES				
MILDEW	Penconazole		40%	10%		
CABBAGE				**−19%**	**50**	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
INSECTICIDES						
INSECT INDOOR	Spinosad		50%	20%	50	
INSECT OUTDOOR	Spirotetramat		50%	10%	50	
HERBICIDES						
WEED	Clopyralid		40%	10%		
CARROTS				**–36%**	**20**	
INSECTICIDES						
INSECT OUTDOOR	Thiacloprid		80%	15%		
HERBICIDES						
WEED	Metribuzin		80%	30%	25	
LETTUCE				**–16%**	**5**	
INSECTICIDES						
INSECT INDOOR	Abamectin		10%	20%		
INSECT INDOOR	Imidacloprid		10%	20%		
INSECT OUTDOOR	Spirotetramat		40%	10%		
FUNGICIDES						
DISEASES	Mandipropamid		20%	40%	25	
ONIONS				**–22%**	**85**	
INSECTICIDES						
INSECTS	Spirotetramat		25%	10%	50	
FUNGICIDES						
DISEASES	Fluazinam		50%	15%	50	
DISEASES	Mancozeb		75%	15%	50	
HERBICIDES						
SPROUTING CONTROL	Chlorpropham		10%	5%	100	
INDUSTRY POTATOES				**–37%**	**125**	
WARE POTATOES				**–39%**	**145**	

Pests	Substance name	Alternatives	Area affected (%)	Yield (Δ %)	Production cost (Δ €/ha)	Additional resistance (Δ %)
SUGAR BEET				**−24%**	**387**	
INSECTICIDES						
SOIL-BORNE INSECTS, THRIPS, APHIDS	Imidacloprid	Force + pyrethroids (spray)	92%	1%	0	
SOIL-BORNE INSECTS, THRIPS, APHIDS	Thiamethoxam	Force + pyrethroids (spray)	8%	1%	0	
FUNGICIDES						
DAMPING OFF	Hymexazol	none	100%	1%	0	
DAMPING OFF	Thiram	Vibrance	100%	1%	0	
HERBICIDES						
WEEDS	clopyralid	none, mechanical weed control	1%	5%	0	
WEEDS	Ethofumesate	none, mechanical weed control	70%	5%	70	
WEEDS	Glyphosate	none, mechanical weed control	100%	5%	140	
WEEDS	Triflusulphuron	none, mechanical weed control	70%	5%	70	
WEEDS	Desmedipham	none, mechanical weed control	100%	5%	70	
WEEDS	Fenmedipham	none, mechanical weed control	100%	5%	70	


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Annex 3
Detailed data sources

BELGIUM

Crop	Source	Data input
MAIZE	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	Departement Landbouw en Visserij	Variable cost; Yield change; Cost change
POTATOES	EUROSTAT	Import; Export
	FIWAP	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change
APPLES	EUROSTAT	Area; Output
	KU Leuven	Yield change; Cost change; Ex-farm price
	Departement Landbouw en Visserij	Variable cost
PEARS	EUROSTAT	Area; Output
	KU Leuven	Yield change; Cost change; Ex-farm price
	Departement Landbouw en Visserij	Variable cost
STRAWBERRIES	EUROSTAT	Area; Output
	Proefcentrum Hoogstraten	Ex-farm price; Yield change; Cost change; Variable cost
LEEKS	EUROSTAT	Area; Output
	INAGRO, Vegras, Sanac	Yield change; Cost change;
	Departement Landbouw en Visserij	Variable cost; Ex-farm price
PEAS	EUROSTAT	Area; Output
	INAGRO, Vegras, Sanac	Yield change; Cost change
	Departement Landbouw en Visserij	Variable cost; Ex-farm price
FRESH BEANS	EUROSTAT	Area; Output
	INAGRO, Vegras, Sanac	Yield change; Cost change
	Departement Landbouw en Visserij	Variable cost; Ex-farm price
LETTUCE	INAGRO	Yield change; Cost change; Variable cost
	Departement Landbouw en Visserij	Area; Output; Ex-farm price
CARROTS	EUROSTAT	Area; Output
	INAGRO, Vegras, Sanac	Yield change; Cost change
	Departement Landbouw en Visserij	Variable cost; Ex-farm price

DENMARK

Crop	Source	Data input
OSR	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	SEGES	Variable cost; Yield change; Cost change
SPRING BARLEY	EUROSTAT	Area; Output; Import; Export
	SEGES	Variable cost; Ex-farm price; Yield change; Cost change
WINTER BARLEY	EUROSTAT	Area; Output; Import; Export
	SEGES	Variable cost; Ex-farm price; Yield change; Cost change
RYE	Danish Statistical Office	Area; Output; Ex-farm price
	SEGES	Variable cost; Yield change; Cost change
SUGAR BEET	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	SEGES	Variable cost; Yield change; Cost change
MAIZE (SILAGE)	Danish Statistical Office	Area; Output;
	SEGES	Variable cost; Yield change; Cost change; Ex-farm price
POTATOES	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	SEGES	Variable cost; Yield change; Cost change
GRASS SEEDS	Danish Statistical Office	Area; Output; Ex-farm price
	SEGES	Variable cost; Yield change; Cost change
WHEAT	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	SEGES	Variable cost; Yield change; Cost change

FINLAND

Crop	Source	Data input
WINTER WHEAT	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost
SPRING WHEAT	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
OATS	EUROSTAT	Area; Output
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
SPRING BARLEY	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
RYE	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
CARAWAY	LUKE	Area; Output; Ex-farm price; Variable cost
	MTK KASTE	Yield change; Cost change
CARROTS	EUROSTAT	Area; Output
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
STRAWBERRIES	EUROSTAT	Area; Output
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
POTATOES	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change
OSR	EUROSTAT	Area; Output; Import; Export
	MTK, KASTE	Yield change; Cost change
	LUKE	Ex-farm price; Variable cost; Yield change; Cost change

GREECE

Crop	Source	Data input
CITRUS FRUITS	EUROSTAT	Area; Output
	OTENET	Ex-farm price; Variable cost; Yield change; Cost change
WINE GRAPES	EUROSTAT	Area; Output; Import; Export
	OTENET	Ex-farm price; Variable cost; Yield change; Cost change
TABLE GRAPES	EUROSTAT	Area; Output; Import; Export
	OTENET	Ex-farm price; Variable cost; Yield change; Cost change
RAISIN GRAPES	EUROSTAT	Import; Export
	OTENET	Ex-farm price; Variable cost; Yield change; Cost change; Area; Output
PEACHES	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	Association of Agronomists-Agro Suppliers	Variable cost; Yield change; Cost change
PEARS	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	Association of Agronomists-Agro Suppliers	Variable cost; Yield change; Cost change
APPLES	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	Association of Agronomists-Agro Suppliers	Variable cost; Yield change; Cost change
ONIONS	EUROSTAT	Area; Output
	Directorate of Agricultural Economy and Veterinary Services	Ex-farm price; Variable cost; Yield change; Cost change
COTTON	EUROSTAT	Area; Output
	Panhellenic Federation of Associations of Agronomists	Ex-farm price; Variable cost; Yield change; Cost change
OLIVES (OIL)	Directorate of Agricultural Economy and Veterinary Services of Trifylia	Ex-farm price; Variable cost; Yield change; Cost change; Area; Output
TOMATO (GLASS)	Directorate of Agricultural Economy and Veterinary Services of Trifylia,	Ex-farm price; Variable cost; Yield change; Cost change; Area; Output
TOMATO (OPEN)	Directorate of Agricultural Economy and Veterinary Services of Trifylia	Ex-farm price; Variable cost; Yield change; Cost change; Area; Output
CUCUMBER	Directorate of Agricultural Economy and Veterinary Services of Trifylia	Ex-farm price; Variable cost; Yield change; Cost change; Area; Output

HUNGARY

Crop	Source	Data input
MAIZE	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change; Import; Export
SUNFLOWER	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change
GRAPES	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change; Import; Export
OSR	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change; Import; Export
APRICOTS	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change
WINTER WHEAT	HAK	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change

ROMANIA

Crop	Source	Data input
MAIZE	EUROSTAT	Area; Output; Import; Export
	APPR	Ex-farm price; Variable cost; Yield change; Cost change
APPLES	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	ICDP Pitesti Maracineni	Ex-farm price; Variable cost; Yield change; Cost change
POTATOES	EUROSTAT	Area; Output; Import; Export
	FNCR	Ex-farm price; Variable cost; Yield change; Cost change
GRAPES	EUROSTAT	Area; Output; Import; Export
	Mircea Marmureanu	Ex-farm price; Variable cost; Yield change; Cost change
TOMATO (OPEN)	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	MARCOSER	Ex-farm price; Variable cost; Yield change; Cost change
OSR	EUROSTAT	Area; Output; Import; Export
	USAMV Bucuresti	Ex-farm price; Variable cost; Yield change; Cost change
WHEAT	EUROSTAT	Area; Output; Import; Export
	USAMV Bucuresti	Ex-farm price; Variable cost; Yield change; Cost change

SWEDEN

Crop	Source	Data input
OSR	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	FADN	Variable cost
	Swedish Association of Seed and Oilseed Growers	Yield change; Cost change
WHEAT	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	FADN	Variable cost
	Swedish Cereal Growers Association, The Rural Economy and Agricultural Societies	Yield change; Cost change
RYE	EUROSTAT	Area; Output; Ex-farm price;
	FADN	Variable cost
	Swedish Cereal Growers Association, The Rural Economy and Agricultural Societies	Yield change; Cost change
BARLEY	EUROSTAT	Area; Output; Ex-farm price;
	FADN	Variable cost
	Swedish Cereal Growers Association, The Rural Economy and Agricultural Societies	Yield change; Cost change
APPLES	Federation of Swedish Farmers	Area; Output; Ex-farm price; Variable cost; Yield change; Cost change
STRAWBERRIES	EUROSTAT	Area; Output; Ex-farm price
	Federation of Swedish Farmers	Variable cost; Yield change; Cost change
CARROTS	EUROSTAT	Area; Output; Ex-farm price
	Federation of Swedish Farmers	Variable cost; Yield change; Cost change
LETTUCE	EUROSTAT	Area; Output; Ex-farm price
	Federation of Swedish Farmers	Variable cost; Yield change; Cost change
ONIONS	EUROSTAT	Area; Output; Ex-farm price
	Federation of Swedish Farmers	Variable cost; Yield change; Cost change
INDUSTRY POTATOES	EUROSTAT	Import; Export for total potato production
	Swedish Potato Growers Association	Area; Output; Ex-farm price Variable cost; Yield change; Cost change
WARE POTATOES	EUROSTAT	Import; Export for total potato production
	Swedish Potato Growers Association	Area; Output; Ex-farm price Variable cost; Yield change; Cost change
CABBAGES	EUROSTAT	Area; Output; Ex-farm price
	Federation of Swedish Farmers	Variable cost; Yield change; Cost change
SUGAR BEET	EUROSTAT	Area; Output; Ex-farm price; Import; Export
	Association of Swedish Sugar Beet Growers, Nordic Beet Research	Variable cost; Yield change; Cost change


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Annex 4
Detailed National Production data

BELGIUM

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
MAIZE	65	740	86
POTATOES	82	3,920	463
APPLES	7	266	121
PEARS	9	316	182
STRAWBERRIES	2	40	96
LEEKS	4	174	72
PEAS	10	70	23
LETTUCE	1	44	30
FRESH BEANS	9	102	20
CARROTS	5	302	22

DENMARK

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
OSR	164	615	235
SPRING BARLEY	529	2,927	515
WINTER BARLEY	119	730	123
RYE	84	498	80
SUGAR BEET	38	2,299	110
MAIZE (SILAGE)	190	6,416	217
POTATOES	38	1,565	155
GRASS SEEDS	54	79	88
WHEAT	653	4,706	824

FINLAND

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
WINTER WHEAT	28	117	21
SPRING WHEAT	209	791	140
OATS	305	1,024	167
SPRING BARLEY	454	1,617	252
RYE	26	81	13
CARROTS	2	68	43
STRAWBERRIES	4	13	54
POTATOES	23	595	74
CARAWAY	12	8	5
OSR	74	98	40

GREECE

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
CITRUS	49	1,105	442
WINE GRAPES	63	575	1,454
TABLE GRAPES	16	271	244
RAISIN GRAPES	38	250	350
PEACHES	38	634	342
PEARS	5	68	69
APPLES	12	268	125
ONIONS	7	227	60
COTTON	283	935	393
OLIVES FOR OIL	1,100	1,600	960
TOMATO (OPEN)	9	285	71
TOMATO (GLASS)	2	137	41
CUCUMBER	3	323	194

HUNGARY

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
WINTER WHEAT	1,059	4,268	623
MAIZE	1,185	6,805	966
SUNFLOWER	566	1,280	404
GRAPES	73	438	124
OSR	223	517	173.7
APRICOTS	5	29	20.5

ROMANIA

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
MAIZE	2,516	9,699	1,406
APPLES	56	503	111
POTATOES	216	3,135	799
GRAPES	176	807	230
TOMATO (OPEN)	27	475	178
OSR	365	831	277
WHEAT	2,080	7,067	1,173

SWEDEN

Crop	Area (1000 ha)	Crop Production (1000 t)	Production value (€ million)
OSR	101	302	105
WHEAT	409	2,536	380
RYE	57	302	42
BARLEY	337	1,580	277
APPLES	1	25	16.4
STRAWBERRIES	2	15	1.9
CARROTS	2	111	57.6
LETTUCE	2	35	22.2
ONIONS	1	51	6.6
INDUSTRY POTATOES	10	470	33.4
WARE POTATOES	14	599	97.0
CABBAGES	0.4	17	6
SUGAR BEET	33.9	2,113	57

Annex 5
Detailed list of 75 at-risk substances

Substance name	Likelihood to be lost	Legislation/cut-off criteria	Source
INSECTICIDES			
CLOTHIANIDIN	High (by crop)	Bee Health - Neonicotinoids	EU Restriction
ABAMECTIN	High	1107/09 - Endocrine Disruption	WRc 2013
BETA-CYFLUTHRIN	Medium	1107/09 - Endocrine Disruption	WRc 2013
BIFENTHRIN	High	1107/09 - PBT/vPvB	CRD 2008 2C
DELTAMETHRIN	Medium	1107/09 - Endocrine Disruption	CRD 2009
DIMETHOATE	Medium	1107/09 - Endocrine Disruption	CRD 2009
ESFENVALERATE	High	1107/09 - PBT CRD	2008 2C
IMIDACLOPRID	High (by crop)	Bee Health - Neonicotinoids	EU Restriction
LAMBDA-CYHALOTHRIN	Medium	1107/09 - Endocrine Disruption	WRc 2013
SPINOSAD	Medium	1107/09 - Endocrine Disruption	WRc 2013
SPIROMESIFEN	Medium	1107/09 - Endocrine Disruption	WRc 2013
SPIROTETRAMAT	Medium	1107/09 - Endocrine Disruption	WRc 2013
THIACLOPRID	High	1107/09 - Endocrine Disruption	CRD 2009
THIAMETHOXAM	High (by crop)	Bee Health - Neonicotinoids	EU Restriction
FUNGICIDES			
BUPIRIMATE	Medium	1107/09 - Endocrine Disruption	WRc 2013
CAPTAN	Medium	WFD - Article 7	ADAS 2010
CARBENDAZIM	High	1107/09 - Mutagenic	CRD 2008 2C
CYPROCONAZOLE	High	1107/09 - Endocrine Disruption	CRD 2009
DIFENOCONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
DINOCAP	High	1107/09 - Endocrine Disruption	CRD 2009
EPOXICONAZOLE	High	1107/09 - Endocrine Disruption	CRD 2009
FENBUCONAZOLE	High	1107/09 - Endocrine Disruption	CRD 2009
FLUAZINAM	High	1107/09 - Endocrine Disruption	WRc 2013
FLUQUINCONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
FOLPET	Medium	1107/09 - Endocrine Disruption	CRD 2009
HYMEXAZOL	Medium	1107/09 - Endocrine Disruption	WRc 2013
IPRODIONE	High	1107/09 - Endocrine Disruption	CRD 2009
MANCOZEB	High	1107/09 - Endocrine Disruption	WRc 2012
MANDIPROPAMID	Medium	1107/09 - Endocrine Disruption	WRc 2013
MANEB	High	1107/09 - Endocrine Disruption	CRD 2009
METCONAZOLE	High	1107/09 - Endocrine Disruption	CRD 2009
METIRAM	Medium	1107/09 - Endocrine Disruption	CRD 2009
MYCLOBUTANIL	Medium	1107/09 - Endocrine Disruption	CRD 2009
PENCONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
PROCHLORAZ	Medium	1107/09 - Endocrine Disruption	WRc 2013
PROPICONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
PROTHIOCONAZOLE	Medium	1107/09 - Endocrine Disruption	WRc 2013

Substance name	Likelihood to be lost	Legislation/cut-off criteria	Source
QUINOXYFEN	High	1107/09 - vPvB	CRD 2008 2C
SILTHIOFAM	Medium	1107/09 - Endocrine Disruption	WRc 2013
TEBUCONAZOLE	Medium	1107/09 - Endocrine Disruption	WRc 2013
TETRACONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
THIOPHANATE-METHYL	Medium	1107/09 - Endocrine Disruption	WRc 2013
THIRAM	Medium	1107/09 - Endocrine Disruption	WRc 2013
TRIADIMENOL	Medium	1107/09 - Endocrine Disruption	CRD 2009
TRITICONAZOLE	Medium	1107/09 - Endocrine Disruption	CRD 2009
HERBICIDES			
AMITROLE	High	1107/09 - Endocrine Disruption	CRD 2009
ASULAM	Medium	WFD - Article 7	ADAS 2010
CARBETAMIDE	High	1107/09 - Endocrine Disruption	EA Compliance
CHLOROTOLURUN	Medium	WFD - Article 7	EA Compliance
CHLORPROPHAM	Medium	1107/09 - Endocrine Disruption	WRc 2013
CLOPYRALID	Medium	WFD - Article 7	EA Compliance
DIMETHENAMID-P	Medium	1107/09 - Endocrine Disruption	WRc 2013
ETHOFUMESATE	Medium	1107/09 - Endocrine Disruption	WRc 2013
FLUAZIFOP-P-BUTYL	Medium	1107/09 - Endocrine Disruption	WRc 2013
FLUMIOXAZIN	High	1107/09 - Endocrine Disruption	CRD 2009
FLUOMETURON	Medium	1107/09 - Endocrine Disruption	CRD 2009
FLUROXYPYR	Medium	WFD - Article 7	ADAS 2010
GLPHOSINATE	Medium	1107/09 - Endocrine Disruption	WRc 2013
GLYPHOSATE	Medium	WFD - UK Spec. Poll'nt (candidate)	DEFRA List
IOXYNIL	High	1107/09 - Endocrine Disruption	WRc 2013
LINURON	High	1107/09 - Endocrine Disruption	CRD 2009
LENACIL	Medium	1107/09 - Endocrine Disruption	WRc 2013
MCPB	Medium	WFD - Article 7	ADAS 2010
METRIBUZIN	Medium	1107/09 - Endocrine Disruption	WRc 2013
MOLINATE	High	1107/09 - Endocrine Disruption	CRD 2009
PENDIMETHALIN	High	1107/09 - PBT	CRD 2009
PICLORAM	Medium	1107/09 - Endocrine Disruption	CRD 2009
PINOXADEN	Medium	1107/09 - Endocrine Disruption	WRc 2013
S-METOLACHLOR	High	1107/09 - Endocrine Disruption	WRc 2013
TEPRALOXYDIM	Medium	1107/09 - Endocrine Disruption	WRc 2013
TERBUTHYLAZINE	High	1107/09 - Endocrine Disruption	WRc 2013
TRALKOXYDIM	Medium	1107/09 - Endocrine Disruption	CRD 2009
TRIFLUSULPHURON	Medium	1107/09 - Endocrine Disruption	CRD 2009
OTHER			
METAM SODIUM	Medium	1107/09 - Endocrine Disruption	CRD 2009
METHIOCARB	High	1107/09 - Bird Safety	EU Restriction

Notes

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