



Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Fakulteten för landskapsplanering,
trädgårds- och jordbruksvetenskap

Survey of regulations concerning pesticides in Sweden and the EU

– Cultivation techniques and competition aspects for Swedish onion and apple producer

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Kartläggning av regelverk kring växtskyddsmedel i Sverige och inom EU – Odlingstekniska och konkurrensmässiga aspekter för Svenska lök- och äppelodlare

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With the hope of enjoyable reading,

Ida Backström

Sammanfattning

Som medlem i EU har Sverige i vissa fall överlåtit bestämmanderätten till unionen. Detta innebär att regler bestämda av EU måste följas i alla medlemsländer, inklusive Sverige. Den Europeiska Jordbrukspolitiken utgör den största delen av EUs årliga budget och är till skillnad från många andra områden helt finansierade på EU-nivå. Det senaste decenniet har många nya regler gällande kemiska produkter och växtskyddsmedel införts vilket inneburit stora förändringar och mycket arbete i hela unionen, så även för Sverige. Sverige har alltid haft en strikt kemikaliepolitik och legat i framkant inom områden som hållbart jordbruk och miljöarbete. För många andra medlemsländer har de nya EU reglerna inneburit åtstramningar i antalet godkända växtskyddsmedel medan det inneburit motsatsen för Sverige. Flertalet produkter som tidigare varit förbjudna i Sverige har i och med de nya reglerna blivit återinförda i landet. I och med detta har Sverige på eget initiativ fortsatt att förbjuda vissa ämnen och har därmed försatt svenska producenter i en situation där produktionen sker på olika villkor i jämförelse med många andra medlemsländer i EU. Detta har medfört debatter i media och ett antal startade projekt för att hitta nya lösningar för att kunna odla specialgrödor utan vissa kemiska produkter som tidigare varit grundpelare i producenternas bekämpningsstrategier.

Det är inte bara Sveriges striktare regler som gjort att villkoren för produktion skiljer sig åt utan även nya regler på EU-nivå. EUs nya växtskyddsförordning (1107/2009) innebär att Europa numer är indelat i tre olika klimatzoner där kemiska produkter måste godkännas separat i varje klimatzon. Sverige ingår i den norra zonen där produktionen, när det gäller specialgrödor, är procentuellt låg i jämförelse med den centrala och södra zonen. Detta gör att ansökningar för godkännande av produkter i många fall enbart görs i centrala och södra zonen där den största ekonomiska vinsten för kemikalieföretagen ligger. Sverige får därmed hitta andra vägar att få kemiska produkter godkända och däribland finns utökad produktgodkännande som alternativ. Alternativa vägar innebär dock en större risk för producenterna där garantierna, både på effektivitet och selektivitet, inte kan ges.

För både äpple och lök, som är grödorna granskade i denna rapport, är bortfallet av kemiska produkter för bekämpning ett stort problem. Båda grödorna har en lång svensk tradition men med något olika förutsättningar.

Problemet med svampsjukdomen fruktträdskräfta i äppelodlingar är vida utbrett och i och med att plantmaterial köps in från utlandet där andra regler gäller hjälper det inte med moderna odlingsstrategier för att undvika smitta. Plantmaterialet är ofta smittat redan från plantskolan, symptomfritt vid inköp, men utan kemiska medel för att hålla infektionen på låg nivå, bryter den lätt ut och kan ge stora förluster i odlingen. Alternativ för att hindra smitta ligger mycket i att hitta tåliga sorter och grundstammar för ympning. I dagsläget finns inget godkänt preparat mot fruktträdskräfta i Sverige. I övriga EU är Merpan, med den aktiva substansen Kaptan, godkänt att användas i odlingen. Detta preparat har sedan ca 10 år tillbaka årligen fått dispens i Sverige för att kunna användas i äppelodlingar efter skörd och något annat hållbart alternativ finns idag inte tillgängligt.

Gällande ogräsproblem i lökodling, kan dessa bli väldigt stora utan välfungerande kemiska produkter. Problemet där ligger i den stora svårigheten att på annat sätt bekämpa ogräset. Löken har dålig konkurrensförmåga och mekaniska rensningsmetoder kräver enorm precision för att inte skada lökens ömtåliga yta. Växtföljden är viktig för att hindra vissa typer av ogräs medan andra fortfarande är svårhanterliga. Stomp, med den aktiva substansen Pendimetalin, har varit förbjuden i Sverige sedan 2008. Precis som Merpan har Stomp årligen sen dess blivit godkänd att användas i lökodling med dispens.

Problemet med förbjudna växtskyddsmedel ligger både av den faktorn att ämnena förbjudits på grund av farliga egenskaper men oftast av den faktorn att ansökan för godkännande inte gjorts eller inte varit tillräcklig. Svenska odlare befinner sig nu i en oviss period där man årligen förlitar sig på godkända dispenser. Olika projekt, finansierade av bland annat Jordbruksverket och LRF, har startats för att hitta ett hållbart alternativ, både på kemisk väg men även genom andra tekniker. Svenska odlare känner sig orättvist behandlade när reglerna inte är samma för alla och de anser att problematiken inte ligger i att ämnen försvinner utan mer i att de inte försvinner konsekvent över hela Europa.

Abstract

As a member of the EU, Sweden has, in some cases, transferred the controlling rights to the Union. This means that the rules defined by the EU must be followed in all member countries, including Sweden. The European Agricultural policy constitutes the largest part of the EU's annual budget and is in contrast to many other areas fully funded at EU level. The last decade, many new regulations on chemicals and pesticides have been introduced which brought great changes and a lot of work throughout the Union, including Sweden. Sweden has always had a strict policy on chemicals and has been at the forefront when it comes to sustainable agriculture and environmental management. For many other member countries, the new EU rules meant cutbacks in the number of approved pesticides while it meant the opposite for Sweden. Most of the products that were previously banned in Sweden have, with the new rules been reintroduced in the country. Despite this, Sweden has by its own continued to ban certain substances. This has forced Swedish producers into a situation where the production in Sweden is based on different rules and conditions in comparison with many other EU member states. This has led to much debate in the media and several projects started to find new solutions for cultivating minor crops. This without some pesticides, previously basic products, in the producers' pest management strategy.

It is not only Sweden's stricter rules that led to production differences but also new rules at EU level. EU's new pest regulation (1107/2009) means that Europe nowadays is divided into three distinct climate zones where pesticides must be approved separately in each climate zone. Sweden is part of the North Zone where production, when it comes to minor crops, is in percentage very low compared to the central and southern zone. This means that applications for approval of products in many cases are only made in the central and southern zone where the greatest economic benefit for chemical companies is located. Sweden needs to find other ways to get pesticides approved and are including off-label approval as an option. Alternative routes entail a greater risk for the producers where the guarantees, both for efficiency and selectivity, cannot be given.

For both apple and onion, which are the crops examined in this report, the exclusion of pesticides is a big problem to combat. Both crops have a long Swedish tradition but with slightly different conditions.

The problem with fungal disease, fruit canker, in apple orchards is widespread, and as the young plants are purchased from abroad where other rules apply it do not help with modern cultivation strategies for avoiding infection. Plant material is often contaminated from the nursery and symptom-free on purchase. Without chemical agents to keep the infection at a low level, breakouts can appear easily and cause huge losses in cultivation. Options to prevent infection include finding resistant varieties and rootstocks for grafting. In the current situation there are no approved fungicides against fruit canker in Sweden. In the rest of Europe Merpan, with the active substance Captan, is approved for use in the cultivation. This product has, since about 10 years, annually been approved an exemption for use in Swedish apple orchards after harvest.

When it comes to onion and weed problems, which has become a huge problem without properly functioning pesticides, the greatest difficulty lies in combating weeds with other techniques. The onion has a very poor competitive ability and mechanical weed control methods requires tremendous precision not to damage the bulb's delicate surface. Crop rotation is important to prevent certain types of weeds while others remain intractable. Stomp, with the active substance Pendimethalin, has been banned in Sweden since 2008. Just as Merpan, Stomp has since then been approved annually for use in onion cultivation with exemption.

Reasons for banned pesticides lie both in the fact that the substances are banned because of the unfavourable effects. The case usually because of the fact that application for approval has not been sent in or sent in but not been adequate enough. Swedish farmers are now in a period of uncertainty and relies yearly on approved exemptions. Various projects, funded from the Swedish Board of Agriculture and LRF, have been launched to find a viable option, both chemically as well as through other techniques. Swedish farmers feel treated unfairly when the rules are not the same for everyone. They believe that the problem lies not in the fact that substances are banned but more in the fact that they are not banned consistent across Europe.

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1. Introduction

1.1 Background

1.1.1 CAP, Common Agricultural Policy

The agriculture and food security became a main issue already in the 1950's when the European cooperation was at its early steps (European commission, 2013b). The main reason was to avoid the lack of food during the time in between war. At that time the cooperation existed out of six member states where they all agreed on a common market and a common price without any duties or charges. The farmers were guaranteed a certain price and if the price were to go below that level the cooperation would go in and pay.

Today the CAP stand for almost half of the European Union budget while the employment in the agriculture production only stand for 5 % of total amount (European commission, 2013b). The explanation for this is that CAP is the only political topic in the union completely financed by the EU without any national supplements at all. So even if the agriculture stands for a low percentage of total employment the topic is still one of the main issues discussed in the EU.

1.1.2 Environmental Policies

The CAP is one important issue in the EU and so is the environment where it will take a lot of effort and combined forces by all member states to deal with today's climate changes and unsustainable use of resources and land (European commission, 2013c). The EU is the only international organization that has the power to adopt environmental regulations that are binding for the member state countries. The EU is at the same time an active driven force in the global work on climate and environment and they work on a range of topics such as: climate changes, health, safe use of waste and pesticides and biodiversity.

In 2007 a major regulation on chemicals and their safe usage was introduced called REACH (1907/2006) (European Commission, 2013d). The regulation deals with registration, evaluation, authorization and restriction of chemical substances and aims to improve the protection of human health and the environment. At the same time EU started a European chemical agency responsible for this regulation.

The EU has also decided on a directive on sustainable use on pesticides (2009/128/EC) where integrated pest management is one part of implementation (European Commission, 2013d).

IPM should be fully implemented in all member states, including Sweden, by 1st of January 2014 and today the Swedish Board of Agriculture is working with implementation of this directive (Sundgren, Agneta, 2013, pers. Comm.). Before the directive was decided Sweden had already come a long way when it comes to integrated pest management, but some regulations had to be implemented in the Swedish environmental code (1998:808).

Already since the 80's the Swedish government has been clear o that the use of chemicals causes risks for humans and animals and effort is taken to reduce the chemical use in society (Wivstad, 2005). In 1999 the Swedish Government set up 15 environmental objectives (today 16) and the use of chemicals is a subtitle in the objective; A non-toxic environment. The objectives are generation goals and aim to be fulfilled during one generation. Since then, further details on each objective have been stated and in the objective 'A non-toxic environment' it has been decided on targets and action strategies to reach the goal. These action strategies include replacing substances with less toxic ones and substances with inadequate documentations and trials should be phased out.

Even though Sweden has come a long way when it comes to sustainable use of pesticides the risk of exposure when importing goods is still relevant (Wivstad, 2005). Therefore it requires international common regulations on the use of pesticides to minimize the risk of exposure. Before the new pest regulation (1107/2009) was decided it was known to the EU that the registration and risk reduction work on pesticides differed a lot from member state to member state where Sweden was then the only member state that had reconsidered approval for all earlier approved pesticides according to regulation 91/414/EEC. When it came to designing a new pest regulation, in this case 1107/2009, Sweden advocated their agricultural policies and regulations as a model and future for the union. Sweden has always been at the forefront when it comes to environmental work and has a long practice of precautionary principles which now the new EU pest regulation (1107/2009) is based on (Sundgren, Agneta, 2012, pers. Comm.).

The work on re-approval for all existing active substances was completed in 2009 and then 1000 substances had been reconsidered (Kemikalieinspektionen, 2009). Out of 1000 substances, 7 % of them were banned cause of their unhealthy mode of action, 67 % of them were banned cause of lack of accurate documentation and trials and about 26 % of them were approved. The earlier and now re-approved substances together with 82 new approved

ones makes it about 330 approved active substances up-taken in Annex 1 in regulation 1107/2009. For many member states this review program was a big change as for Sweden none of the banned substances were earlier approved in the country. This was because Sweden had done this re-approval process already. On the other hand about 30 active substances, earlier banned in Sweden were approved and listed in Annex 1. As the pest regulation (1107/2009) is directly applied into Swedish laws the opportunity to nationally ban substances are small but can be done through climate conditions special for Sweden (Wivstad, 2005). One opportunity is also to make the Swedish market refrain these substances and LRF has taken a policy decision on not recommending these substances to farmers.

1.2 Problem Description

Sweden is one of the countries in the EU with strictest regulations on the use of pesticides in agriculture (Wivstad, 2005). Although the new pest regulation is applied directly into Swedish law the Swedish government together with the Swedish Chemicals Agency has chosen to continue with banning some of the substances earlier banned but approved by EU. In some cases this is due to climate and health risks and in some cases due to that no applications or incomplete applications have been sent in for approval (Bergkvist, Peter, 2013, pers. Comm.). Some Swedish farmers now stand before a future where fewer options on chemical treatments are possible and no other choices available (Ragnarsson, Sara, 2013, pers. Comm.). The result of fewer available pesticides can be increased treatment pressure of some pesticides which in the next step can lead to higher risk of resistance and unmanageable pest problems (Jordbruksverket, 2011). If the production of a certain crop stops due to lack of effective pest management this does not only effect the production itself but also entrepreneurship, employment and rural development.

In 2011 the Swedish government gave the mission to investigate the consequences of decreasing numbers of pesticides on the market to the Swedish Board of Agriculture (Jordbruksverket, 2011). The aim of the report was make a strategy to better know beforehand what crops and pests that can become more difficult in the future. With better anticipation of future development they hope to avoid situations where growers are completely without options and solutions.

Membership in the EU is said to facilitate trade between member countries and equal rights and opportunities for all member states (EU, 2013e). When the rules for the producers are different between countries, even though the new pest regulation was a step in the right direction for harmonization, they have different conditions for its cultivation and product. By banning certain active substances and pesticides, authorized by EU, Sweden has a position involving stricter rules in the cultivation and production (Manduric, Sanja, 2013, pers. Comm.).

How do these decisions affect Swedish producers and which cultivation techniques are they required to carry out with the banning of certain pesticides? Is this an opportunity for growers to be competitive against other producers in Europe or do the prohibitions involve major changes in farming with little return?

It is a great thing to say that Sweden is a leading country when it comes to environmental and climate work. But, in the shadows of this success do we find a darker future for Swedish producers and farmers?

1.3 Aim

The report aims to identify the active substances where different rules apply to Swedish and other European producers. The survey intends to find out why these substances are banned and how that affect growers. What measures have been undertaken since it was banned and whether it is satisfying for growers that the substance is prohibited.

The report also aims to look at new cultivation techniques introduced due to the restriction of pesticides on the market. How the new technique works and if, why and how the technique are effective or not against certain pest problems.

In the end the report also aims to look in competitive commercial aspects to see if these new techniques will make Swedish producers able to maintain their production and market share.

1.4 Limitations

The delimitation of the report is done by only looking at two different cultures and one certain pest problem in each cultivation. The two crops were chosen due to the education history of the author and due to that the two crops and chosen pesticides have been largely debated in media. Both of the chosen cultivations are horticulture crops and the chosen pesticides have been approved to be used on an exemption in cultivation the last cultivation season.

Annual outdoor crop → Onion

Perennial outdoor crop → Apple

1.5 Questions and Hypothesis

Based on the aim of the report questions and a hypothesis were formulated. The report is based on these.

- ➔ What are the rules regarding Pesticides in Sweden and the EU on the crops and active substances selected in the report?
- ➔ Are the rules different in Sweden compared to the EU? If so, how?

The hypothesis of this report is that the rules regarding pesticides in Sweden differ from other member countries in the EU. Because of these differences in regulations Swedish producers are forced to cultivate chosen crops differently than before, with new techniques and pest management strategies. By this new way of cultivating Swedish producers have competitive problems against other European producers due to the new higher cost of cultivation.

Competitive problems in the next step lead to an uncertain future for Swedish producers and a higher rate of imported products.

1.6 Definitions and translations

EU	- European Union
Pesticides	- Chemical or biological product aimed to prevent or counteract damage from animals, weeds or microorganisms. Pesticides are divided into two group; biocide products and plant protection products.
Plant protection products	-A type of pesticide aimed to be used in agriculture to protect plants against pests.
CAP	- Common agricultural policy. The common policies on agriculture in the EU.
EU-regulation	- Regulations made at EU level and directly applied onto national regulations.
EU-directive	- Directives are implemented into national regulations. They can be both harmonizing and minimum regulations.
LRF	- Federation of Swedish Farmers. An organization for Swedish producers.
Crop rotation	- Rotation of crops each year to avoid certain problems instead of cultivating the same crop on the same land each year.
Risk Assessment	- Trials made on active substances that is compulsory to get a substance approved.
IPM	- Integrated pest management.

Swedish Board of Agriculture	-	Jordbruksverket
Swedish Chemicals Agency	-	Kemikalieinspektionen
Environmental Protection Agency	-	Naturvårdsverket
Swedish environmental code	-	Miljöbalken
Sweden's environmental objectives	-	Sveriges Miljömål
Ministry of rural affairs	-	Landsbygdsdepartementet
Ministry of environment	-	Miljödepartementet

2. Materials and methods

The facts in the report are divided in two different types of references where one is a literature study based on document report and written material and the other is based on interviews.

The report is divided into four different parts where the first part is a survey over regulations and authorities responsible for the area included in this report.

The second part includes explanation of the chosen cultivations, their production and their pest problems. Included in this part is also a survey over current regulation regarding the chosen pesticides and cultivation strategies to overcome chosen pest problems.

The third part includes future aspects on Swedish production of chosen cultivations and Sweden's work in the area.

The fourth, and last, part of the result in this report is an analysis of the competitiveness of Swedish producers on the market. Different aspects is discussed and finally put into 'Porters five force model' explaining competitive aspects for Sweden producers on the market today (Harvard University, 2013).

2.1 Chosen references

The method of the report was to first start with the literature study to get a good picture on the subject and which persons that would be useful and important to interview along the way.

2.1.1 Literature study

The literature study is mainly included into the first two parts of the result where the actual regulations regarding pesticides are the base. The different regulations, both Swedish and European ones, are explained shortly in the report to get an understanding how the area is regulated and by whom.

The active substances, their mode of action and trials on those are mentioned to understand why the regulations look that way and it is also stated how the regulations differ from the EU to Sweden.

The literature study continued after the interviews when certain areas were mentioned by the interviewed persons as important topics, such as new strategies and main future aspects.

2.1.2 Interviews

The interview study started by doing a survey over the different steps of the value chain. The ones who take the decisions and the ones that are affected by it. A coarse overview of the value chain steps was drawn to help find suitable persons to interview.

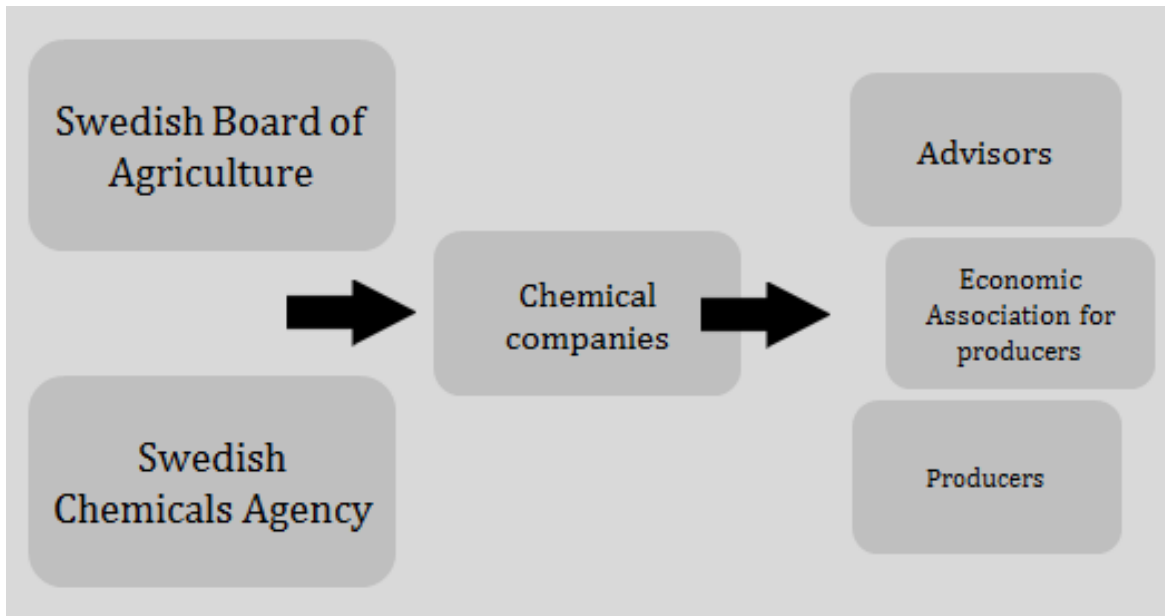


Figure 1: A broad picture and chain on who is responsible and who is effected by decisions taken.

Interviews with persons from each group were priority and a few other interviews, outside the picture, were included along the work.

All the interviews, besides from the ones with the producers, were semi structured and more of a discussion while the interviews with the producers were strict to get clear and easy comparable result. Some interviews were actual meeting while others were conducted over the phone. In some cases supplementary questions after the interviews was conducted via e-mail. During all interviews notes were conducted that in retrospect were assembled into coherent text by the author. The interview template for the producers is shown in appendix 1.

2.1.2.1 Interviewed persons

Gunnel Larsson is an advisor at Grön Kompetens AB and wrote, together with others, a report in 2011 on quality and growth in onion produce (Olsson, et. al, 2011). Due to this report an interview with Gunnel was used as an early inspiration on the subject to brain storm on different aspect to focus on when it came to production and entrepreneurship.

Agneta Sundgren at the Swedish Board of Agriculture is responsible for implementation of the new directive on sustainable use of pesticides and has since the directive was decided on worked with information and education in the area. Discussion with her took place during a presentation she held in 2012 that included future challenges for Swedish producers and an interview in the end of the work with this report.

Peter Bergkvist at the Swedish Chemicals Agency is an authority expert and is extremely knowledgeable in the area on how chemicals are applied for approval and how the process works. The interview with Peter Bergkvist aimed to get a better picture on how the Swedish chemical agency works and why.

Gunilla Persson and Helena Nylund at Nordisk Alkali AB were interview to talk about how they, as a chemical company, handle banned products and substances and how they look at the future for producers with other products or no products available. During the interview questions on how the regulations affect their company were discussed and the reactions that they get from their customers, advisers, distributors and users.

Sanja Manduric and Sara Ragnarsson work as advisors at the Swedish Board of Agriculture in the plant protection centre in Alnarp. They are advisors on fruits & berries and field vegetables and not only advisors to producers but also work with strategic action plans for future conditions in Swedish production.

One project mentioned by Sara Ragnarsson and Sanja Manduric where the 'Minor use' project financed by the Swedish Board of Agriculture and LRF. The project aims to increase the options of pesticides on the market for minor crops. Therefore an interview with Christina Marmolin, who is the project manager, took place. This interview is not included as a part in figure 1 but included along the work.

Tomas Isaksson (2013, pers. Comm.) is the CEO at Kalmar- Ölands trädgårdsprodukter that is a producer organization for vegetable producers including onion as a major crop. Today

including about 175 producers in several parts of Sweden. The interview aimed to see how they look upon changes in regulations and what they do for their members. The same kind of interview took place with Lars-Olof Börjesson who is the CEO at Äppelriket, also a producer organization but for fruit producers. Äppelriket has about 100 fruit producers as members and they are mainly located in Skåne.

At last interviews were made with producers of both onion and apples to examine how they look on the regulations on plant protection products, what kind of pest problems they have and if or how they changed their production according to new rules. All interviewed producers are anonymous in the text and the thought of doing the questionnaires was to identify differences in cultivation and their way of thinking.

Four apple producers were interviewed, all of them situated in Skåne and all of them members of the producer organization Äppelriket. Their area of cultivation was from 10 hectare up till 45 hectare and they all produced according to IPM.

Four onion producers were also interviewed where two of them cultivated mostly agricultural crops and two of them were more focused on horticultural crops. Their area of onion cultivation was from 20 hectare up to 100 hectare. The two agriculture farmers were members of the producer organization Kalmar Ölands trädgårdsprodukter and situated on Öland. The other two, situated in Skåne, had their own cooperatives and other farmers produced for them.

3 Result

3.1 Regulations regarding pesticides in the European Union

The overall regulations on agriculture in the EU is called CAP and stands for Common agricultural Policy (EU, 2013b). The policy aims to ensure that food production works together with an economically viable rural and environmental measure for safety in areas like climate, water resources, bio diversity and use of energy. Today EU is the world's largest importer of food but one goal with CAP is also to double the food production in the area by 2050 and still taking good considerations into sustainable use of resources and the environment. The union has proposed several reforms which emphasize sustainable farming practices, innovation and research – and a fairer system of aid to help member state farmers to cope with future challenges on the market.

EU directives is to be transposed into national laws while EU regulations has to be applied in all member states regardless of nation legislation (Naturvårdsverket, 2013c).

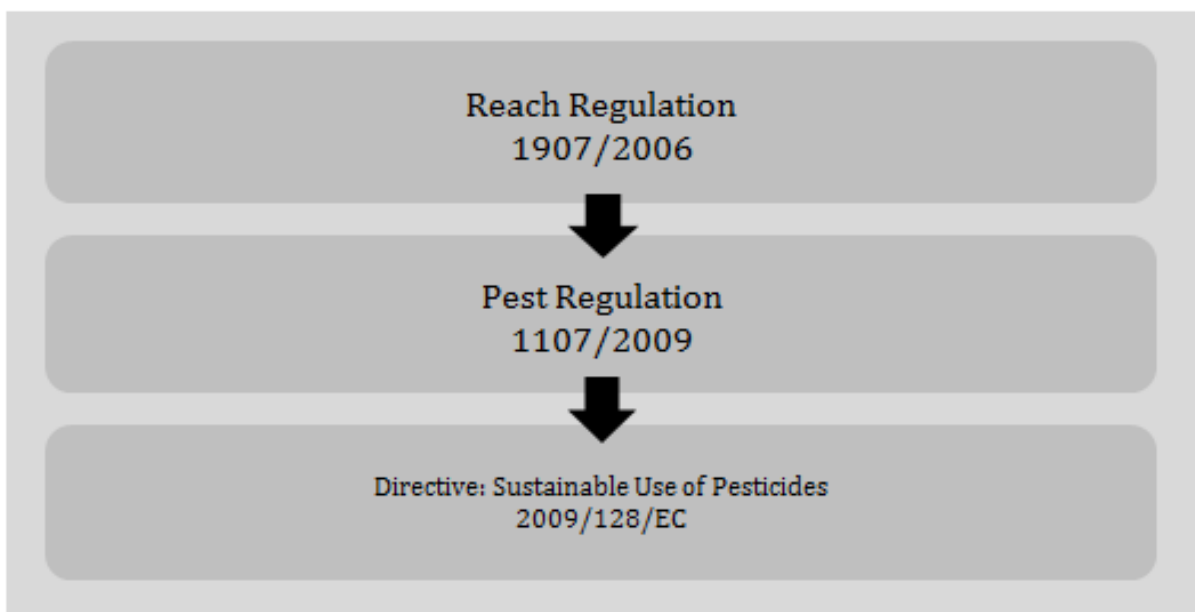


Figure 2: European regulations and directive and which are based on the other.

3.1.1 Reach (1907/2006)

The Reach regulation stands for Registration, Evaluation, Authorization and Restriction of Chemicals and was approved in the end of 2006 by the European parliament (Official Journal of the European Union, 2006). This regulation replaced most of the earlier regulations regarding chemicals and the act took effect 1 June 2007 and the regulations was introduced step-wise and will have its total effect in 2018 (Kemikalieinspektionen, 2013h). The regulation

is applied directly in Swedish activities and is not translated into Swedish regulations. The regulations is based on the principle that manufacturers, importers and downstream users are responsible to ensure that the substance that they produce, put on the market or use will not cause adverse effects on health and environment. This regulation goes further than earlier regulations in the area demanding higher requirements for producing, trading and use of pesticides.

3.1.2 Pest Regulation (1107/2009)

This regulation is concerning placing pesticides on the market and replaced the directive 91/414/EEC (Official Journal of the European Union, 2009). The updated regulation was fully implemented in 2011, but some of the regulations is approved to be applied fully in a period of five years, this to get a good implementation period for the member states. Approved substances in the earlier directive are also approved in the updated version but when it comes to re-approval of substances new strategies and regulations for approval is applied. The regulations contain strict processes for approval of substances both on European level and on national level of each member state. The new regulation primarily aim to ensure safety for humans, animals and environment when it comes to the use of pesticides but also to remove barriers for trading these products between member states (Kemikalieinspektionen, 2013i). The regulation contain new rules when it comes to climate zones for approval of substances and cooperation between member states. Europe is now divided into three different climate zones; north, central and south where the same regulations occur in the same zone. Products need to be applied for approval in each climate zone and the application must include trials and documentation from the same climate zone. Substances that are carcinogenic, mutagenic and toxic for reproduction are banned other than in exceptional cases.

3.1.3 Sustainable use of pesticides (2009/128/EC)

The European Union has set rules for sustainable use of pesticides through the directive 2009/128/EC that is based on the pest regulation 1107/2009 (European Commission, 2013a). The directive aims to reduce risks and impacts on people's health and the environment due to the use of pesticides. The directive include minimum requirements that needs to be fulfilled by every member state. The directive were to be implemented as a whole in 2011 but the part on Integrated Pest Management (stated in article 14 of the directive) has been

postponed to 1st of January 2014. Besides requirements of IPM the directive also set up rules on establishment of competent authorities and certifications systems, training of pesticide user, distributors and advisors and monitoring systems.

3.2 Responsible authorities in European Union

Decisions and work in the EU is taking place on different levels where the highest court is the European council where all national leaders of the member states are represented (EU, 2013c). In other parts on the work experts and representatives of particular areas are involved. The European council works with future strategies for the union in bigger contexts while the lower courts are taking the actual decisions in particular areas. All representatives in the EU are elected by the population in each member state.

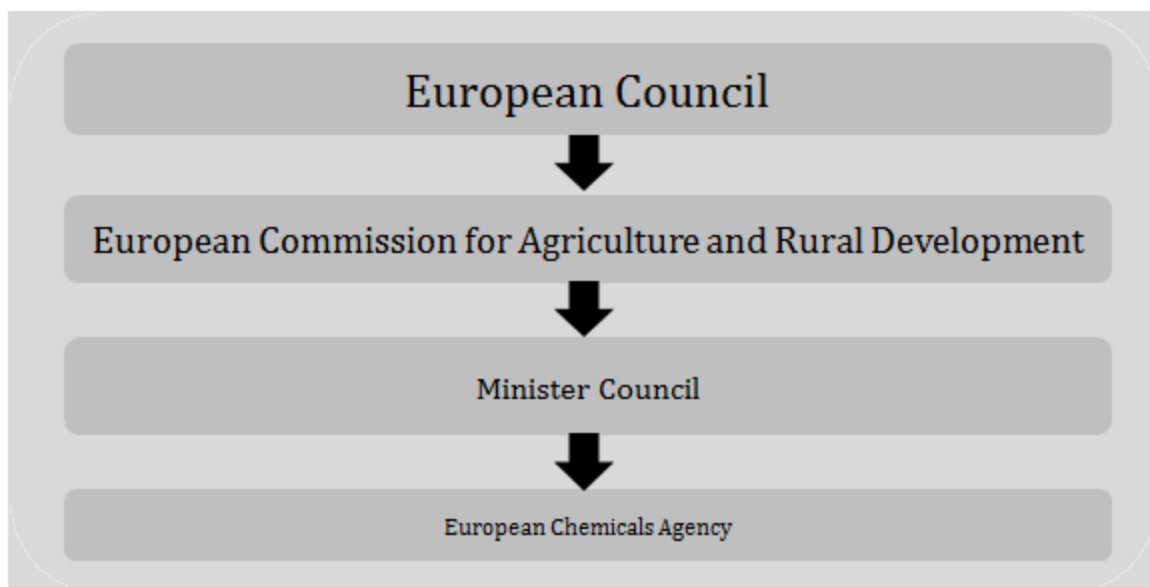


Figure 3: Decision chain within the European Union.

3.2.1 European Commission for Agriculture and Rural Development

The European Commission's Directorate-General for Agriculture and Rural Development is based in Brussels and are responsible for implementation of policies regarding agriculture and rural development (EU, 2013d). Their work includes farm support, market measures, financial and legal matters, quality policies, analysis and evaluation and international relations relating agriculture. When decisions and laws were to be decided the minister council, consisting of all ministers from all member states on the current topic, legislates and enter agreements that the commissions in the next step has to work with (EU, 2013c).

3.2.2 European Chemical Agency (Echa)

The European chemicals Agency is the administrator of Reach (1907/2006) within the whole European Union (Echa, 2013). They consider scientific and technical research for decisions when it comes to chemical substances used in Europe and they evaluate and approve testing methods to decrease the number of animal testing and to ensure safe products on the market. They give information and advice on pesticides to all member states of the EU.

3.3 Swedish regulations regarding pesticides

Since Sweden is a member of the European Union (EU) they comply with the decisions taken in the EU and has transferred the decision right to them in certain topics (Riksdagen, 2013c). The Swedish parliament makes sure that the EU does not make decisions that Sweden is better deciding themselves and takes part in different institutions of the EU.

When deciding on new entries or changes of existing laws the decisions is taken in the parliament and the government is then responsible to ensure that decisions are implemented. This together with various governmental agencies and in accordance with global and major decisions taken in the EU. Below, some of the major laws and regulations including pesticides are being explained.

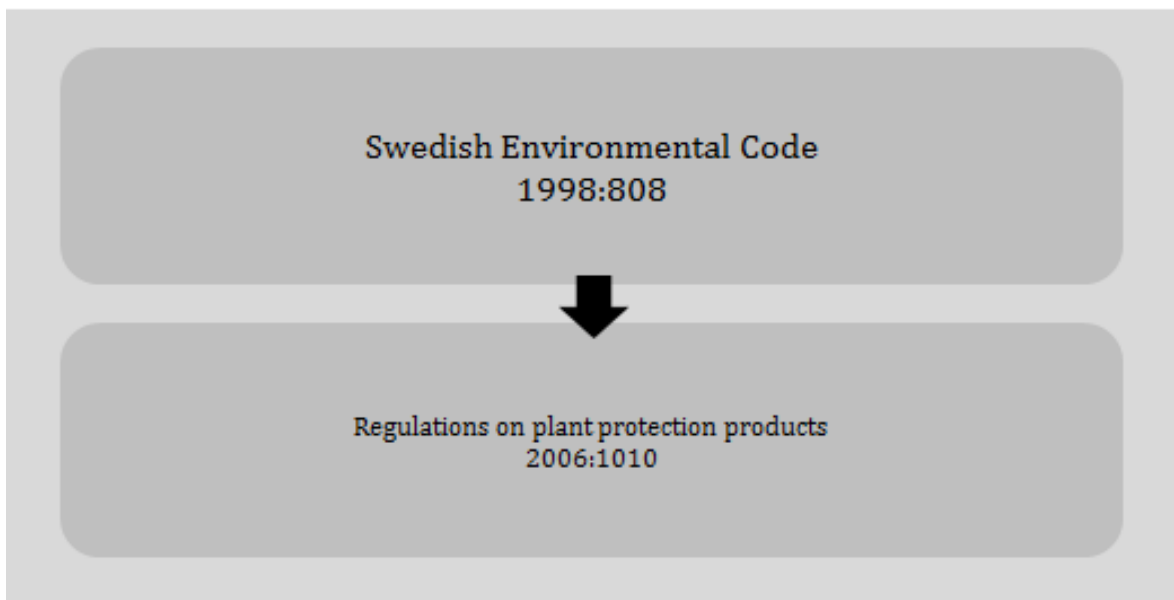


Figure 4: Swedish regulations and in which order they are regulated.

3.3.1 Swedish environmental Code (Miljöbalken 1998:808)

The Swedish environmental code aim to provide a healthy and sustainable environmental development for present and future generations (Riksdagen, 2013a). The environmental code

is applied to protect human health and environment from damage and to care for valuable natural and cultural environments. It is applied to ensure sustainable management when it comes to the use of land and resources in both ecological, social, cultural and economic terms. The Swedish environmental code is divided in 7 parts, including 33 chapters and about 500 paragraphs. To this, and supported by this, code a large number of rules and detailed regulation is included (Naturvårdsverket, 2013b). In chapter 14 (Chemical Products and Biotechnical Organisms) regulations on pesticides is listed, from registration and approval of products, trading, handling and regulations on exemptions (Riksdagen, 2013a). Regulations within the EU on environmental issues is incorporated in the Swedish environmental code (Naturvårdsverket, 2013b). The law was introduced 1st January 1999 and replaced and combined several minor environmental laws in to one (Riksdagen, 2013b).

3.3.2 Regulation on Plant protection products (Förordning Om växtskyddsmedel 2006:1010)

This regulation is based on and supported by the Environmental code (1998:808) (Riksdagen, 2013d). The Regulation includes IPM and a limited use of pesticides. It also includes the requirements for the pesticide to be approved, responsible authorities and regulations concerning the use, storage and sale. Some of the rules of the regulations were introduced 1st of October 2006 and others are still to be implemented (Sundgren, Agneta, 2013, pers. Comm.). Rules regarding IPM are still, in writing of this report, not finished although the rules are to be introduced in 2014.

3.3.3 Swedish environmental objectives

The Swedish parliament decided in 1999 on environmental objectives to make an active stand for a better environment for the next generation (Naturvårdsverket, 2013a). The environmental objectives are not laws but benchmarks for Sweden's environmental work and they are therefore not included into figure 4.

Today there are sixteen environmental objectives and two of them has a direct correlation with the use of pesticides in cultivation and production; 'A non-toxic environment' and 'A varied agricultural landscape' (Naturvårdsverket, 2013a). The Swedish chemical agency is the responsible authority for the first one mentioned and the Swedish Board of Agriculture is responsible for the second one. The objectives are supposed to be reached until 2020 and yearly they evaluate the work that has been done. The environmental objective; A non-toxic

environment is defined that the presence of chemical substances in the environment, caused and extracted by society, must not be harmful to human health or biodiversity and that the substances impact is negligible (Miljömål, 2013a). By risk assessments, approval and registration of pesticides the harmful effect will hopefully decrease. The environmental objective; A varied agricultural landscape is defined that the value of the agricultural landscape and agricultural land for biological production and food production should be protected while biodiversity and cultural values are preserved and strengthened (Miljömål, 2013b). Biodiversity and cultural values in the environment is dependent on the methods used in agriculture. The method should be environmental friendly but still efficient and competitive among others.

3.4 Responsible authorities in Sweden

The Swedish government is the main responsible authority in Sweden and included in the government are the Ministry of Rural affairs and the Ministry of Environment (Regeringen, 2013). The ministries then have several departments and governmental agencies to help them with their work to live up to and follow the regulations mentioned above.

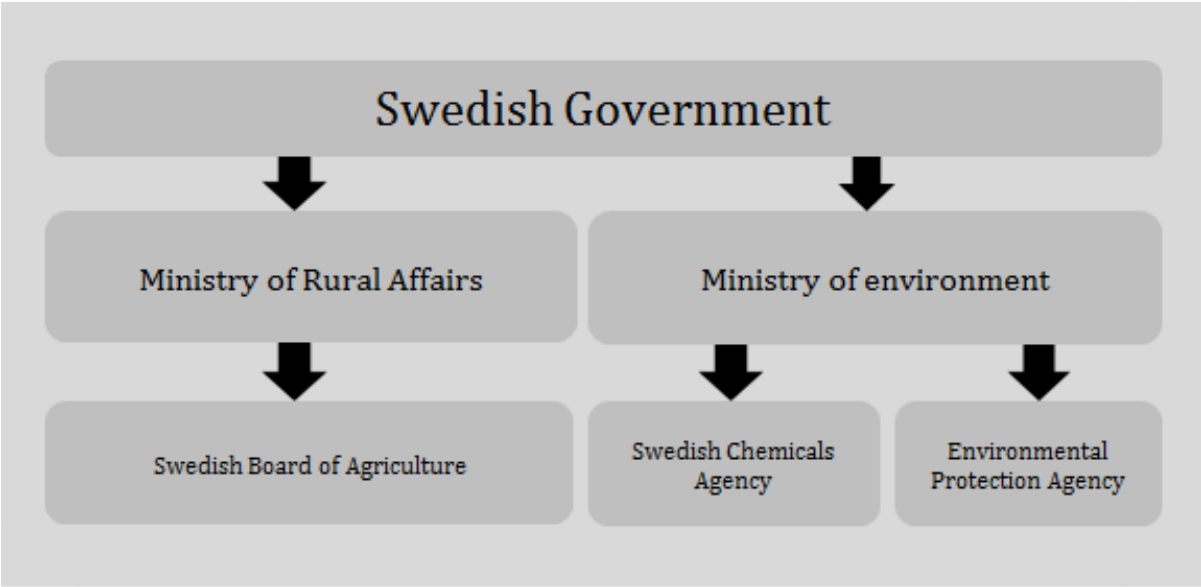


Figure 5: Responsible authorities in Sweden.

3.4.1 Swedish Board of Agriculture

The Swedish board of Agriculture, Jordbruksverket in Swedish, is an authority in the Ministry of Rural Affairs (Landsbygdsdepartementet, 2013). They are assigned to work for a sustainable development, good animal welfare, a dynamic and competitive industry in

Sweden and a food production that benefits the consumers (Jordbruksverket, 2013b). In efforts to manage the EU's agricultural policy the Swedish board of Agriculture has the central and coordinating role among relevant authorities and is the accredited paying agency for agricultural and rural subsidies (Jordbruksverket, 2013a). On behalf of the government they participate actively in Sweden's work with rural policy development and are responsible for implementation of the CAP (Common agricultural policy). The Swedish Board of Agriculture is responsible for the environmental objective 'a varied agricultural landscape' and works mainly with that through education, advising and information.

3.4.2 Swedish Chemicals agency

The work of Swedish Chemicals agency, Kemikalieinspektionen in Swedish, is fundamentally based on laws and regulations in European union and in Sweden and their work is valued both nationally and internationally (Kemikalieinspektionen, 2013a). The Swedish Chemicals Agency is based under the Ministry of Environment and actively participates in the work with the EU plant protection regulation (Regulation (1107/2009) and represents the Swedish government in negotiations within the EU. The Swedish Chemicals agency is responsible for the environmental objective 'Non-toxic environment' explained earlier in this report (3.3.3). All pesticides used in Sweden must be approved by the Swedish Chemicals agency (Kemikalieinspektionen, 2013f). Pesticides should follow rules on classification, labelling, MSDS and be registered in Swedish Chemicals agency's product register. The Swedish Chemicals agency is also a reviewing unit for pesticides including, if pesticides have an approval, that the amount of active substance is in accordance with the authorization and that the products meet the requirements of product information.

3.4.3 Environmental Protection Agency

The Environmental Protection Agency, Naturvårdsverket in Swedish, works on behalf of the Swedish government and is the authority in Sweden with overview on how the environment is doing and how Sweden's environmental work is progressing (Naturvårdsverket, 2013d). The agency is also responsible to coordinate, monitor and evaluate the work on Sweden's environmental objectives.

The environmental protection agency participates in the development of laws regarding environmental issues and supports the Ministry of environment with decision making information in several areas (Naturvårdsverket, 2013b). They also support other agencies with

their work on the Swedish environmental code. The Environmental protection agency works with the EU mainly within the European Commission's expert groups and executive committees (Naturvårdsverket, 2013c).

3.5 Annual crop – Onion

Production of onion in Sweden has more than 50% of the domestic market share and the production is mainly located in the regions of Skåne and Kalmar County (Olsson et al., 2011). During October-December the Swedish market share is almost up to 80% while during May-July when there is no Swedish production the onion is imported mainly from Netherlands and Spain. In some cases onion is even imported from New Zealand. In 2008 the area for onion production was 849 ha and that counts for about 18% of the cultivated area in Sweden. The same year, as previous mentioned, there were around 300 domestic producers of onion.

3.5.1 Cultivation

A well-drained soil, with high humus content is suitable for cultivation of onion (Ögren, 1992). The onion has short and thick roots that are sensitive to anoxia therefore the soil needs to be loose. Onions can be planted as seed, bulb or seedling and in Sweden the most common way to do it is by seeds. The seed germinates in low temperature (~5°C) and can be planted in Sweden in early spring. Weed is one of the biggest problems in cultivation since onion has a very poor competitive ability. The harvest may drop drastically if weed presence is abundant, especially in the beginning of the cultivation. Mechanical weed control must be done with great caution and in early stages of cultivation to make the risk of disruption and damage on the onion as small as possible. For this reason chemical herbicides are often used in cultivation.

3.5.2 Chosen pesticide: Stomp SC (BASF, 2012)

Active substance: Pendimethalin (CAS: 40487-42-1)

Stomp SC was chosen for the reason that it has been highly debated in media because of new regulations- Stomp SC is one of the basic products included in a pesticide strategy against weed in onion production.

3.5.2.1 Practical use

Stomp is a selective chemical herbicide and is used on grassy weed species and broadleaf weeds (BASF, 2012). The herbicide is a suspension concentrate that is suspended in water and sprayed on field. Best result is obtained by spraying in combination with rainfall since the

effect is better when the soil is moist. In onion cultivation the pesticide is sprayed on field from right after seeding until one week before the plant emergence or when the bulb is about 10 cm (Jordbruksverket, 2012). Stomp is a pesticide in authorization class 2L which means that the chemical is only allowed to be used by authorized certified personal in commercial farming (Andersson et al., 2005).

3.5.2.2 Mode of action

Stomp, with the active substance Pendimethalin, works systemically and is absorbed through soil and leaves (BASF, 2013). The substance is then spread by the xylem to the whole plant (Kemikalieinspektionen, 2013b). The substance inhibits cell elongation and mitosis in the weed (BASF, 2013).

3.5.2.3 Risk assessments

Studies on Pendimethalin generally show low acute toxicity (EPA, 1997). Minor toxic effects, i.e. irritation, have been observed when Pendimethalin has been introduced through the oral and eye route but the substance is practically non-toxic when introduced through the dermal and inhalation route. Studies made on animals' show that Pendimethalin causes thyroid follicular cell adenomas in rats and the substance is therefore classified as a possible human carcinogen. This risk should mainly be considered for handlers involved in direct treatment with Pendimethalin and does not apply to the general population.

In environmental studies very low levels of Pendimethalin have been detected in ground water (EPA, 1997). The contamination risk is slightly higher in surface water due to drift off from spraying and run off from rainfall. This risk is, however, low since Pendimethalin has a high tendency to bind in soil and sediment particles and this lowers the concentration of the substance in surface water. Pendimethalin shows to be slightly to moderately persistence in aerobic soils and the persistence is decreasing with increasing of temperature and moisture. Studies also showed that Pendimethalin does not represent a high risk to general aquatic animals and plants even if high doses were applied though certain endangered species have been shown to be more sensitive to the substances.

3.5.3 Regulations and exemptions

Both the European and the Swedish regulations are only focused on the active substance Pendimethalin in this part of the report. The rules differ from each other and they are therefore explained separately below.

3.5.3.1 European Union Regulations

In the regulation 91/414/EEG the substance Pendimethalin was an accredited substance according to Annex 1 (Official Journal of the European Union, 2009). The decision to include the substance in annex 1 was decided in 2003 and was executed in 1 January 2004 (Official Journal of the European Union, 2003). When the regulation was replaced by No. 1107/2009 new decisions were made whereas Pendimethalin was still accredited until 31 December 2013 (according to previous decision) under certain circumstances that should be considered by every member state of the European Union (Official Journal of the European Union, 2011). These circumstances are stated to be that every member state consider the protection of aquatic organisms and terrestrial plants that are not targeted and the possibility of short-range atmospheric transport of the active substance. In 2012 the European Union took the decision to extend the period of approval until 31 July 2016 (Official Journal of the European Union, 2012). The period was extended due to the time required to apply for a new approval of the substance.

3.5.3.1 Swedish regulations

According to the Swedish chemicals agency Pendimethalin is categorized as a 'Priority risk reduction substance' which means that the substance should be handled with extra care due to its dangerous properties (Kemikalieinspektionen, 2013c). A risk assessment should be done in each individual case of use and a substitution substance should be considered.

The approval for Stomp SC expired in Sweden 31 December 2008 and was not allowed to be used after 31 December 2010 (Kemikalieinspektionen, 2013e). In 12 October 2010 LRF applied for an exemption to be able to use the herbicide in commercial production of inter alia, onion. The application was rejected by the Swedish chemicals agency in 26 October 2010 and, since LRF saw a big risk with producing onion without the herbicide, the decision was appealed to the Swedish environmental court where it was approved to be used during the period 15 March 2011 until 15 July 2011. The Swedish environmental court claimed that the herbicide should follow equivalent rules as in Denmark where the herbicide is approved. Approved conditions for the exemptions says that the herbicide is only to be used once during the cultivation season and the maximum dose of use is 1,8 l/ha and that required safety distance to rivers should be 30 m. The following cultivation year of 2012, LRF applied for another exemption to use the herbicide and the application was approved and allowed to be

used during the period 25 March 2012 until 23 July 2012 with the same regulations as the previous year (Kemikalieinspektionen, 2013d).

3.5.4 Alternative Strategies

The alternative strategies are divided in to three parts; Chemical, Preventive and Cultivation strategies.

3.5.4.1 Chemical strategies

The development of new chemical herbicides useful in onion cultivation is slow due to the fact that most of the European member states still uses Afalon, which is very effective against annual weed (Ragnarsson, Sara, 2013 pers. Comm.). Afalon is a selective herbicide with the active substance Linuron (Bayer Crop Science, 2013). In Sweden Linuron is a cut-off substance due to its harmful effects both on humans and environment (Kemikalieinspektionen, 2013j). The product Afalon was forbidden in onion cultivation in Sweden in 1990 and then a new strategy, including Stomp as a substitute were introduced (Ragnarsson, Sara, 2013, pers. Comm.). Now Swedish farmers' stand before the same kind of dilemma again but no new effective products has been yet approved and Afalon is not to be re-registered in Sweden again.

When looking through approved products against annual weeds there are a few still approved ones but according to both Tomas Isaksson (2013, pers. Comm.), CEO at Kalmar- Ölands trädgårdsprodukter, and Sara Ragnarsson (2013, pers. Comm.), advisor at Swedish Board of Agriculture, these are not enough. To get a good result on weed control with minor risk for resistance it is exemplary to use several products in a pest management strategy. When only a few products are available these are used more frequent and when signs of resistance is shown there are no options available.

Geranium acid and weed vinegar are options with acceptable effect on weed before the cultivation crop emergence (Jordbruksverket, 2011). Practical problem when using these substances is the large amount of water needed for dissolvent and treatment and the cost of the product. A costly treatment with only acceptable effect is not a long term sustainable weed control management.

3.5.4.2 Preventive strategies

The major preventive strategy on weed control is the crop rotation (Jordbruksverket, 2011). By avoiding onion cultivation on fields with high weed pressure you can decrease the amount of weed problems in the cultivation. Since onion is a crop with low competitiveness against weeds, it is important to minimize the root-weeds since they are the one most difficult to treat once the onion is established in fields.

Many of the onion producers in Sweden are common farmers and the crop rotation include different types of agricultural varieties (Ragnarsson, Sara, 2013, pers. Comm.). By rotating the varieties in a proper way you can be able to prevent certain weeds in field. Figure 6 shows crop rotation as it looks like for a common farmer but also for a producers cultivating more minor crops and horticulture crops.

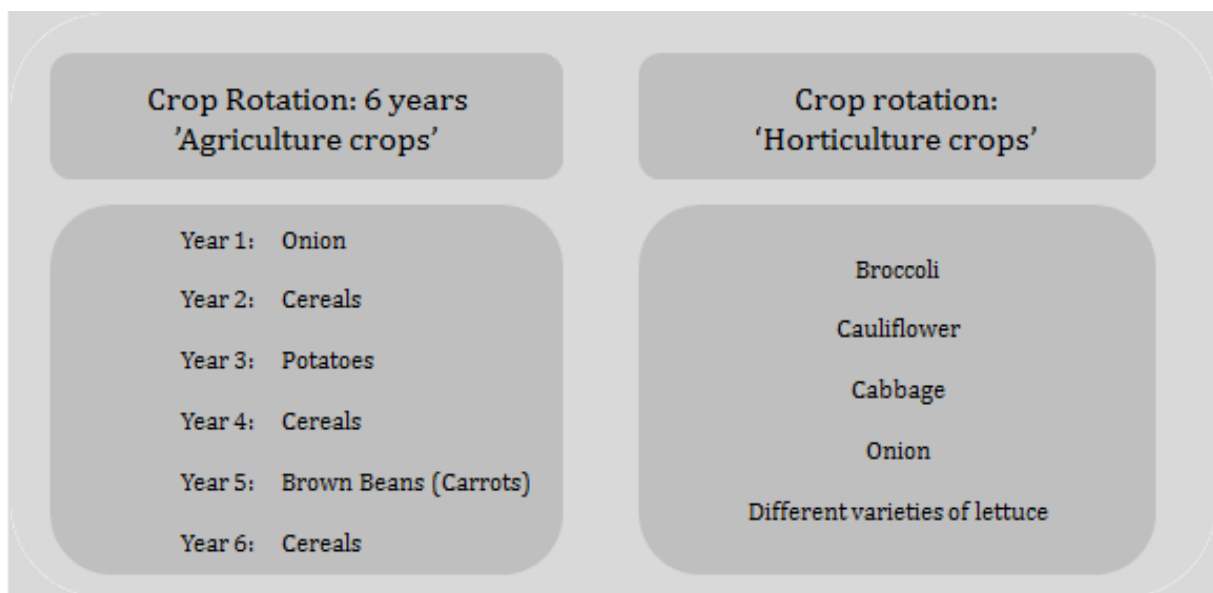


Figure 6: Different crop rotations depending on type of farming.

3.5.4.3 Cultivation strategies

Due to the implementation of the directive on sustainable use of pesticides an IPM program is necessary in all types of cultivation (Sundgren, Agneta, 2012, pers. Comm.). This has led to a strategy including both mechanical and chemical control in onion cultivation (Ragnarsson, Sara, 2013, pers. Comm.). By using mechanical strategies between the rows of cultivation and only chemical treatment in a small stripe just on the rows the amount of chemicals used can be decreased. With no chemical options for treatment of certain weeds this weed control management is not possible and other techniques must be found.

The only cultivation strategy in field is then mechanical treatment both by machines and by hand (Ragnarsson, Sara, 2013, pers. Comm.). In organic production of onion weed control by hand is the most common one but the amount of time and labour for this type of weed control is high and not very cost effective.

A new mechanical weed control machine is now available on the market that uses video image analysis techniques to be able to locate individually cultivated plants and then remove weeds inter row and within the crop row between plants where other machines cannot reach (Ragnarsson, Sara, 2013, pers. Comm.). The machine can be used on most crops planted in regular rows that are clearly separated from the next plant. This machine is expensive to buy and not an option for a small farmer but for bigger ones. For farmers with a normal agricultural crop rotation, this machine might be a big investment while for other farmers mostly cultivating minor crops the machine can be used on several cultivations and the cost can therefore be split.



Figure 7: Robocrop used in field on planted seedling of onion in small groups.

Photo: Johan Ascard.

The limitation of the machine is its speed where this machine is a slow worker, and some weed control by hand is still necessary since the result of 'Robocrop' is not 100%. In the report 'Pesticide Strategy' that the Swedish Board of Agriculture published in 2011 a table including costs for different techniques of weed control methods is shown. The table is including costs for the 'Robocrop' and some weed control by hand. The table below shows the cost difference between the techniques that the Swedish Board of Agriculture calculated in their report. They included costs on purchasing equipment and maintenance, number of run through the field and the cost of labour. By looking at Table 1 it is easy to see that

different techniques for weed control cost differently. Chemical treatment in field is a fast way and only cost a third of what it would do with treatment including 'Robocrop'.

Table 1: Total cost for weed control management during one season and one hectare of land with different techniques (Jordbruksverket, 2011. Page 110).

Type	Time	Cost (SEK)	Difference (SEK)
5 times chemical treatment + 2 times Weed control by hand	3,5 h	5 312	
4 times hand-driven "finger-wheel" + 2 times weed control by hand	76 h	17 512	12 201
3 times 'Robocrop' + 2 times weed control by hand	65 h	20 704	15 393

To get a good use of this weed controlling technique including 'Robocrop' another type of cultivation technique in onions is required where you plant seedling instead of sowing the seed directly in field (Ragnarsson, Sara, 2013, pers. Comm.). When planting seedling you plant them in small groups instead of one by one.

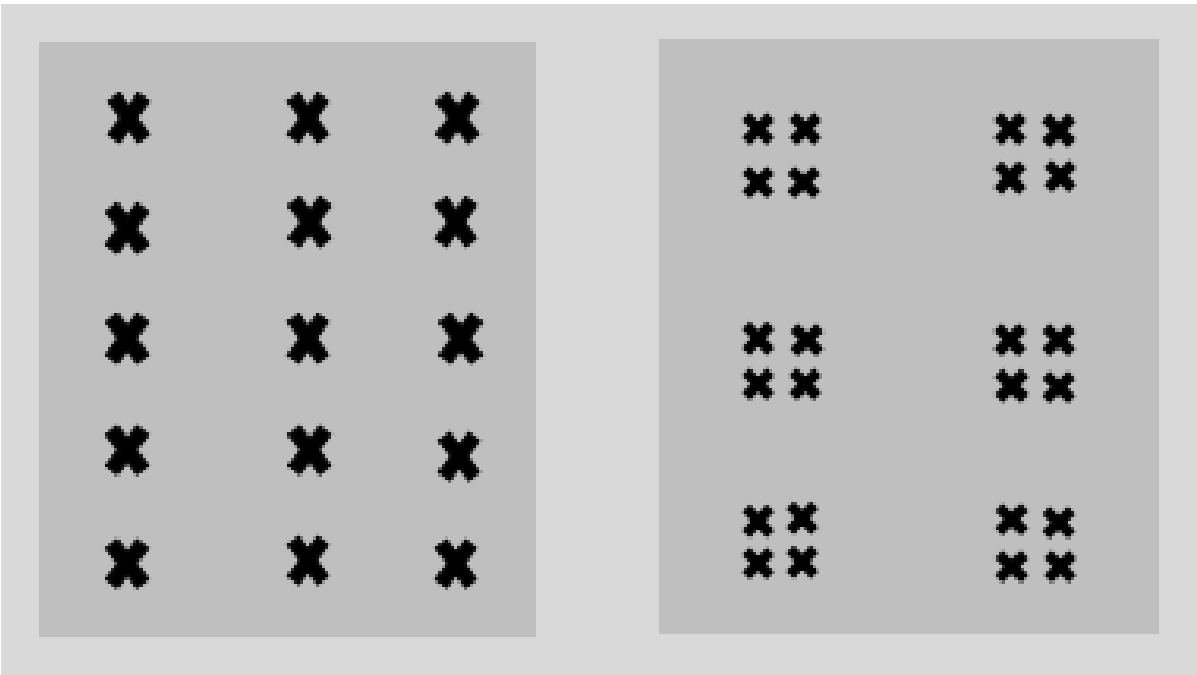


Figure 8: The left picture shows regular rows in cultivation while the right picture shows the cultivation technique when planting seedling.

By planting seedlings they already have a greater competitive ability than the others and the amount of produced onion does not differ although a greater plant spacing is needed

(Ragnarsson, Sara, 2013, pers. Comm.). To buy seedlings, if it's not possible to grow them yourself, is a greater cost than buying seeds and the machines for planting seedling instead of sowing is not a common part of a regular machinery at a farm and can therefore be an expensive investment.

3.6 Perennial crop – Apple

During 1980–2008 the amount of consumed fresh fruit in Sweden increased by 28% (Jordbruksverket, 2010). The consumption of apples is one of the highest proportions in the statistic but overall the consumption of apples has decreased over the last five decades due to more exotic fruit like bananas and kiwis (Fernqvist et. al., 2011).

Apples produced in Sweden have its peak season during September-December where Swedish apples stand for about 50% of the market share. Due to new storage technology (ULO-storage) the Swedish producer are able to extend the season but still not enough to gain more market shares where consumers expect apples all year around (Ekenstierna, 2004). The rest of the season most of the apples are imported from Italy, France and Germany and altogether they stand for more than 80% of the yearly consumption (Fernqvist et. al., 2011). The cultivating areas for apples are highly concentrated around Kivik in the east part of Skåne and since 1983 the harvest trends for Swedish apples has been positive despite the decreasing areas for cultivation (Ahnström, 2005). This can be explained by intensification and new cultivation techniques.

3.6.1 Cultivation

Apple is a perennial crop where the trees in cultivation can give good returns for about 15-20 years (Korsgaard et. al., 2007). For this reason the climate and place where the plantation is situated is crucial. The soil needs to be in good shape and of well structure and so has the shape of the trees being planted. Many orchards in Sweden are located on well drained soils close to water streams which decreases the risk of frost in early spring (jordbruksverket, 2013c). On a location like this the risk of leakage and run offs is bigger and therefore it is important that the cultivation has a good management when it comes to irrigation, fertilization and spraying. To establish an orchard about 2500-3000 trees are planted on each hectare and the slender trees are held up by poles and iron wires (Einarsson, 2010). They are pruned in a way to give the trees maximum light and as many flower buds as possible. In this

way the yield per tree increases and the harvest is easier managed. The modern trees are often grafted in either one or two different steps to get a tree more adapted to the climate and more resistant to certain pests (Jordbruksverket, 2013d). One of the major uncertainties in orchards are the weather which can cause great damage during cultivation both direct and indirect (Einarsson, 2010). Direct damages are for example frost and hail damages and indirect damages can be seen as favourable climate for fungal infections. One common fungal disease seen in many orchards today is fruit canker (*Nectria galligena*) which causes rough sunken portions of the bark that can lead to that the infected area rot, dries and dies (Pettersson et. al., 1998). Damages like this can cause great economic loss in cultivations (Swiergiel et. al., 2010). Pruning is important to do with great knowledge to avoid infestation as an infected tree is hard to cure. Great knowledge is also important when it comes to healthy, resistant cultivars and reduced contagion risk within the cultivation.

3.6.2 Chosen pesticide: Merpan 80 WG (Nordisk Alkali AB, 2011)

Active substance: Captan (CAS: 133-06-2)

Merpan 80 WG was chosen because of major problems with fruit canker in cultivations mentioned during study visits made by the author. It was also especially interesting to investigate the product more because of the fact of its several approved exemptions during the last decade.

3.6.2.1 Practical use

Merpan 80 WG is a contact acting fungicide used to prevent fungal infections in cultivation after harvest (Nordisk Alkali AB, 2011). The fungicide is a water dispensable granule and is regulated to be used only in commercial cultivation with required authorization (class 1L) (Andersson et. al., 2005). The trees must be sprayed preventive with the fungal pathogen and be covered with the active substance to prevent infection (Olvång, 2001). The effect is maintained by continuous spraying after harvest and during leaf drop when the trees are especially susceptible to infection due to open wound surfaces.

3.6.2.2 Mode of action

Merpan 80 WG, with the active substance Captan, is a fungicide that affects several different chemical processes in the fungal cell (Olvång, 2001). The main effect is due to denaturation of certain proteins, thereby disrupting certain enzymes normal function in the fungal cell.

3.6.2.3 Risk assessment

Risk assessments of Captan made by European Food Safety Authority (EFSA) showed that the substance have low toxicity when introduced through the oral and dermal routes but toxic when inhaled (European Food Safety Authority, 2009). Test made at the same time also showed that Captan was not irritating to the skin but severely irritating to eyes. Tests made on mice show that the substance had no genotoxic potential but was found to cause duodenal tumours and is therefore classified as R40 (suspected to cause cancer) and carcinogenic category 3 (European Food Safety Authority, 2009 & Nordisk Alkali AB, 2011). Captan has high mobility in soil but under aerobic conditions in soil and surface water the substance shows very low persistence due to high biodegradability (European Food Safety Authority, 2009). The acute and short term risk from uptake of contaminated food items and drinking water is low both for mammals and birds. However, a high long-term risk is assessed on insectivorous birds and herbivorous mammals who are repeatedly exposed to the substance. The risk for the nearby aquatic environment is also high and therefore spaying buffers are required.

3.6.3 Regulations and exemptions

Both the European and the Swedish regulations are only focused on the active substance Captan in this part of the report. The rules differ from each other and they are therefore explained separately below.

3.6.3.1 European Union regulations

In 2007 the decision was taken to include Captan as an approved substance in Annex 1 in the European council directive 91/414/EEC (Official Journal of the European Union, 2007). When this directive was replaced by EC 1107/2009 Captan was, according to No 540/2011, still an approved substance. In the European Pesticide database the substance is approved until 30 September 2017 under special conditions controlled by each affected member state (EU, 2013a & Official Journal of the European Union, 2011). The special conditions of consideration are safety for the user, exposure through food for consumers and the protection of birds, mammals and aquatic organisms.

3.6.3.2 Swedish regulations

According to the Swedish chemicals agency Captan is categorized as a 'Priority risk reduction substance' which means that the substance should be handled with extra care due to its

dangerous properties (Kemikalieinspektionen, 2013g). A risk assessment should be done in each individual case of use and a substitution substance should be considered.

The last fungicide including Captan as an active substance was forbidden in Sweden in year 2000 (Eriksson, 2012). Since 2002 LRF has applied yearly to be able to use the substance in commercial apple cultivation against fruit canker (Kemikalieinspektionen, 2011). The application for exemptions has been approved every year due to the reason that no other pesticide for fruit canker is available on the market and that the fungi can cause great damage to the Swedish fruit industry if not concurred. The applied exemptions were also approved for the cultivation year of 2012 (Jordbruksverket, 2013e). Further conditions for approval are that the substance is only allowed to be used after harvest and maximum 3 times a year. Special considerations are also regulated when it comes to safety distances and safety for the person spraying the pesticide in field.

3.6.4 Alternative strategies

The alternative strategies are divided into three parts; Chemical, Preventive and Cultivation strategies.

3.6.4.1 Chemical strategies

The so called 'Bordeaux-fluid' was developed in the 1880s where its active substances, copper sulphate (CuSO_4) and slaked lime ($\text{Ca}(\text{OH})_2$) was a very effective pesticide against fungal diseases in wine plantations (Nilsson, 2013). Copper is still effective against fungal diseases but has been forbidden in Sweden for a long time due to its adverse environmental effects. It is still used in many other European countries but Sanja Manduric (2013, pers. Comm.) on the Swedish Board of Agriculture do not think that re-approval of copper products is an option and something the Swedish government would consider.

Since fruit canker is a common and big problem in Swedish orchards a chemical solutions is necessary to handle infestations (Manduric, Sanja, 2013, pers. Comm.). Today there are no available products for chemical treatment of fruit canker available in Sweden.

The method to cope with fruit canker problems in orchards today includes pastes, containing clay, for application on to wounded areas (Swiergiel, 2010). The wounds are cut clean and the paste is applied onto the stem. The paste includes organic substances that prevent new infestations on the surface and enhance the resistance of infection in wood and over waxing.

The paste can also have a positive effect when applied on other bark and stem damages such as pruning and defoliation wounds. But using the paste in all kinds of wounds, including defoliations wounds, this method can be extremely costly and laborious.



Figure 9; Left Picture: Stem infected by fruit canker. Centre: wound cut clean. Right: Wound treated with paste.

Photo: Weronika Swiergiel.

3.6.4.2 Preventive strategies

Choosing the right variety is extremely important in apple production due to its long cultivation time and also a variety that is suitable for the consumers during the whole cultivation time (Börjesson, Lars-Olof, 2013, pers. Comm.). Swedish apples have a long tradition and many of the varieties are not the most exemplary kinds but simply popular by the consumers due to their long tradition.

Äppelriket has introduced a new variety called 'Frida' that is a crossbreed between a Canadian Scab resistant variety and Aroma (Börjesson, Lars-Olof, 2013, pers. Comm.). The variety 'Frida' is then more resistant than many other varieties in orchards today. Äppelriket is always searching for "better" varieties to produce but even with better varieties fungal diseases is still a problem due to its high spreading pressure. One problem with new, more resistant varieties, is also the actual time for cultivation. Although the variety is more resistant than others when planted the resistance often lays in only one gene and the chance of that gene keeping its resistant properties for 20 years of cultivation time is small (Manduric, Sanja, 2013, pers. Comm.). Many of the resistant varieties today demand some, but less, chemical treatment and with no approved product on the market this is not possible.

One preventive strategy is of course to make sure that the plant material bought for establishment is healthy (Manduric, Sanja, 2013, pers. Comm.). Most of the small apple trees are brought in from Holland and Belgium but there is no control method to make sure the

trees are healthy and not only symptom-free. In many cases they may look healthy because of the simple reason that in Belgium and Holland a whole range of fungicides are approved and applied constantly to prevent break outs. For example, the active substance Captan, can easily be used 10 times during one cultivation season. When arriving to Sweden the trees look healthy but with no more chemical treatment the fungi, that works systemic in the tree, blooms out. Even though the plant material might be healthy when arriving the cluster cultivations of apples existing today makes the spread for the fungi easy (Börjesson, Lars-Olof, 2013, pers. Comm.).

The new European directive on sustainable use of pesticides includes implementation of IPM but when it comes to Swedish Apple producers they have been practicing according to IPM for a long time (Manduric, Sanja, 2013, pers. Comm.). The Swedish Board of Agriculture works a lot on forecasting and warning techniques but many of these strategies aims to get a more effective chemical treatment. A more effective chemical treatment can lead to better results in less applications but for this strategy chemical treatments are included and with no pesticides available this strategy is less effective. The strategy is based on controls in fields to determine when it is most suitable and necessary for chemical treatment.

3.6.4.3 Cultivation strategies

Apples today are often grafted on one type of rootstock, another type in-between and then the actual fruit setting variety on the top (Jordbruksverket, 2013d). By cultivation the apples in this way you get a tree more optimal for current climate conditions. The rootstock and the variety in between can be of a more fungi resistant kind so that infection through water splash can be decreased.

By pruning the trees in a certain way the aim is to optimize the sun light that reach through the tree crown and by that get sunlight on the fruit and get a dryer climate in the tree (Lövendahl, Erik, 2012, pers. Comm.). With a lighter and dryer tree crown with a lot of sunlight the environment is more hostile for the fungi to establish. This together with a good drainage in the soil can stop the fungi to spread (Swiergiel, 2010). It is also important to immediately after detecting infection remove damaged areas.

3.6 Future aspects and possibilities

Along with new regulations and less approved pesticides the Swedish Board of Agriculture and LRF took action in order to increase the possibilities for Swedish producers (Manduric, Sanja, 2013, pers. Comm.). Different projects were financed and reports published in order to highlight the problem and the uncertain future for Swedish production of minor crops. This part includes both crops chosen in the report.

3.6.1 Swedish pesticide strategy

In 2011 the Swedish Board of Agriculture published a report on a pesticide strategy due to the decreasing amount of approved pesticides in Sweden (Manduric, Sanja, 2013, pers. Comm.). The report includes strategies to predict the availability of products in the future and a risk analysis of what consequences this might have on Swedish producers. The importance of the report is the cooperation between all stakeholders such as chemical companies, advisors, politicians and farmers. The report aims to come with a strategic plan to identify the most serious pest problems in the future and solutions to cope with it. The problem today is forecast on approved products since this is hard to predict as it is and without having a good forecast new strategies are hard to come up with in such a short time. In the report 'Swedish pesticide strategy' both of the chosen crops in this report are included (Jordbruksverket, 2011). This meaning that pest problems in those chosen crops are common problems and issues severely affected by new regulations and re-approval of pesticides. Before the new European pest regulation the Swedish chemicals agency analysed the risks and benefits of the product in cultivation when approving a product while now they only consider the risk (Bergkvist, Peter, 2013, pers. Comm). By this report the Swedish Board of Agriculture focuses on the benefits as well and they hope that this can affect the Swedish chemicals agency when it comes to approval of products (Manduric, Sanja, 2013, pers. Comm.).

3.6.2 Project: Minor Use

The project 'Minor Use' was introduced when signs showed that Swedish producers lost competitiveness against other European countries (Marmolin, Christina, 2013, pers. Comm.). One of the reasons for this was the fact that several pesticides had been banned in Sweden and not in other member states of the EU. The project is financed by the Swedish Board of Agriculture and LRF and started in 2007. It will continue until 2015, when it will be evaluated. The main purpose of the project when it started was to find new ways and other chemical

strategies to deal with certain pest problems. Minor use focuses on minor crops that is more affected, due to its small percentage of cultivation, by new regulations regarding approval of pesticides. The project can finance both trials that are missing to get an approval and trials on new strategies including not only chemical pest management. The projects and areas to focus on are proposed both from farmers, producers and stakeholders. This project can have great help from the 'Swedish pesticide strategy' mentioned in the piece of text above when it comes to predicting problem areas to focus on.

3.6.3 Parallel trade and Off-label approval

According to article 51 and 52 in the EU directive 1107/2009 new ways for approval of pesticides is current (Official Journal of the European Union, 2009). One of the new ways to get an approved product is by parallel trade. This means that approval for a product approved by another member state can be approved in the applicant country if it can be identified as equal to another product already approved. For approval it is therefore important to have a reference product and the approval of use is equal to the rules regarding the reference product.

When it comes to Off-label approval this means that one product can be approved to be used on another crop (Jordbruksverket, 2011). The product should be approved in the member state and the off-label approval stands for extending approval of that product in to another minor crop. An approval like this cost less than a normal approval but the application must come from the farmers and the company producing the product has no responsibility for uncertain effects in production (Manduric, Sanja, 2013, pers. Comm.). This approval needs only residue studies as a base for approval while normal applications needs both residue studies and efficiency- and selectivity tests (Persson, Gunnel & Nylund, Helena, 2013, pers. Comm.). Under these circumstances this can be a huge risk but also a possibility for the producers. The risk is that the product approved by off-label is less selective and less effective than a product aimed for the crop and this can lead to great uncertainty in cultivation. The uncertainty in cultivation is also the result of that the off-label approval is not approved by the company producing the product and therefore they are not responsible for the outcome. In some cases where the off-label approval is well known to be efficient the producing company can place the off-label use on the label of the product but unless it is there they disclaim themselves for unexpected results. The possibility for the producers is to get an

approved chemical strategy for less money and the dependence from companies producing chemicals. Many companies today do not apply for approval of products used in minor crops in the northern climate zone because of the small percentage of production it stands for and the low income it can bring.

3.7 Competitiveness of Swedish producers

Competitiveness of Swedish farmers against other producers in Europe depends on different aspects both from European regulations but also the willingness to change and improve by the farmers themselves. Three different aspects that can be both positive and negative for Swedish producers are discussed below.

3.7.1 Dividing Europe into three climate zones

According to EU pest regulation 1107/2009 all member states are nowadays divided into three climate zones (Northern- central- and south zone) (Official Journal of the European Union, 2009). These climate zones are separated when it comes to use and approval of pesticides where one product must be approved separately in each and every zone as long as the active substance is listed in 'Annex 1' of approved substances.



Figure 10: Member states included in the different climate zones.

The different zones are mentioned in figure 10 where the northern zone, where Sweden is included, is the smallest one. According to Peter Bergkvist (2013, pers. Comm.) at the Swedish Chemicals Agency, this type of zoning demands great cooperation between the member states in each zone and a good cooperation comes with a lot of advantages. By dividing into

zone costs for approval of products can be less since several countries can cooperate. The zoning can be seen as a way to harmonize the market and compromising between countries. Peter Bergkvist (2013, pers. Comm.) also mentions that the cooperation in the northern zone has been ongoing for a long time so the difference is not that big and could possibly be more difficult in the other two zones.

When discussing with others another opinion appears where some negative effects on the climate zones are mentioned. Since the northern zone is the smallest it is sometimes not prioritized, at least not for minor crops (Manduric, Sanja, 2013, pers. Comm.). When looking at the percentage of cultivation in fruit as an example, the northern zone only produces 4 % of the total amount (Persson, Gunnel & Nylund, Helena, 2013, pers. Comm.). With this low percentage many of the companies producing chemicals only apply for approval of their product in the central- and south zone where they can simply sell more and earn more. When looking at substances no longer approved, the most common situation is that no application for approval has been sent in or it has been sent in but not with enough data and documentation (Bergkvist, Peter, 2013 pers. Comm.). So is the case with the fungicide 'Merpan 80 WG'. The company Maktheshim owns Merpan but has not, since the new regulation, sent in an application for re-approval of the product in the northern zone. Captan is the active substance and another product produced by a French company including Captan was applied for approval a few years ago but the application was denied due to lack of accurate documentation (Persson, Gunnel & Nylund, Helena, 2013, pers. Comm.).

By doing this climate zone classification the northern zone has become a bit of an outsider, especially when it comes to minor crops (Ragnarsson, Sara, 2013, pers. Comm.). Low interest by chemical companies can cause great damage for producers when products are no longer available.

3.7.2 Co-operatives and producer organizations

For both crops chosen in this report there are producer organizations; Äppelriket and Kalmar-Ölands trädgårdsprodukter. Both of these cooperatives help their members with everything from establishing, consulting, packaging, storing and distribution (Isaksson, Tomas, 2013, pers. Comm. & Börjesson, Lars-Olof, 2013, pers. Comm.). By being a member in those co-operatives producers can avoid major investment needed for example for storage and instead

get their products stored by someone else. The CEO for Äppelriket, Lars-Olof Börjesson (2013, pers. Comm.), says that the greatest thing with a cooperation is the fact that all knowledge in the production is gathered at one place. They offer the producers pest management consulting, education in new techniques and strategies and the producers can focus on what they are best at, producing.

If you are an approved producer organization it is possible to get EU subsidies to strengthen the producers place on the market (Jordbruksverket, 2013f). By these subsidies large investments can be made in order to expand, streamline and improve the overall production. The subsidies are given to the cooperative, not to the single producer (Larsson, Gunnel, 2013, pers. Comm.).

During the interviews most agreed on the importance of help when it comes to advisors and education to cope with new regulations and new strategies obligatory in field. Because of this many producers see a membership in a co-operative as a huge advantage, at least if the producer is a small size one. For new producers it can also be an advantage to be member of a co-operative to get the start-up help you need and be sure that your yield is sold in the end. In both co-operatives mentioned above the co-operatives has most customer and consumer contact (Börjesson, Lars-Olof, 2013, pers. Comm.). By being a big co-operative they are able to negotiate for a better price than a small single producer would be able to. Many of the big wholesaler's prefer to make business with co-operatives since there is less administration and contact with many more suppliers instead of only one as in this case.

One thing about co-operatives that should be considered when discussing competitiveness against others can be the fact that the direct consumer contact can be lost (Larsson, Gunnel, 2013, pers. Comm.). By having good contact with customers and consumers, knowing their needs, wants and buying behaviour producers are able to produce a product that the consumers in the end want (Börjesson, Lars-Olof, 2013, pers. Comm.). Consumer contact can be a great market advantage when other competitors can offer a better price. Äppelriket has a long tradition with consumer based marketing and consumer activities and it might be the reason for their success in many ways (Börjesson, Lars-Olof, 2013, pers. Comm.).

3.7.3 Organic production as a competitive advantage

Both Äppelriket and Kalmar- Ölands trädgårdsprodukter has members producing apples and onion in an organic way (Isaksson, Tomas, 2013, pers. Comm. & Börjesson, Lars-Olof, 2013, pers. Comm.). Organic producers are less than conventional producers and most of them smaller in size. Lars-Olof Börjesson (2013, pers. Comm.) explains that changing an apple orchard from conventional to organic is almost impossible and if apples are to be produced organic this is often decided in the initial state of plantation. He also believes that organic apples may have a market advantage in the fact that the consumer actually differ but that the great mass of the population chooses apples on other premise such as variety and tradition.

It is a different situation when it comes to onion where the price is the major focus for customers and consumers and less tradition is involved (Larsson, Gunnel, 2013, pers. Comm.). Organic production of onion is not as well spread as organic production of fruit and berries and this could be due to the fact that you don't often eat the onion uncooked or unpeeled which you do with apples (Sundgren, Agneta, 2013, pers. Comm.). Organic production of onion is also very small due to the difficulties with managing weeds without chemical treatment as mentioned in chapter 3.5.1.

Both the project 'Minor Use' and 'the pesticide strategy plan' aims to find other pest management strategies to both cope with the fact that less approved products will be available over time and to decrease the amount of pesticides used in production (Sundgren, Agneta, 2013, pers. Comm.). One solution to full fill both aims are of course to produce organic, but others cost and investments should also be considered in this case. The mechanical method of controlling weed in onion with 'the Robocrop' is an organic method but when looking at figure 7 the cost of this method is rather high compared to chemical strategies and not an option for everyone (Ragnarsson, Sara, 2013, pers. Comm.).

3.7.4 Innovation among producers

The main aspect in successful production of crops is the mind setting of the producers (Larsson, Gunnel, 2013, pers. Comm.). Some changes in production are voluntarily and often based on viability and some changes are more compulsory and therefore considered a greater risk and a higher investment (Larsson, 1995). Even a forced change should be seen as an opportunity and not a step back and the reason for the change must be understood. Producing crops today is more than just farming but a life as an entrepreneur. Many

producers today are just that, and they are able to adapt to changes quicker and earn more money from production by it.

Both apple and onion cultivation carry out a long tradition in certain areas of Sweden and there adapting and changing throughout time can be harder (Larsson, Gunnel, 2013, pers. Comm.). Both of these cultivations in large scale appear in clusters where most producers are placed close together which can be preferable and storage and distribution is close by while a negative effect can be increased pest pressure due to poor arable soil and increased risk for contagion because of minor areas of cultivation. Starting up cultivation in new areas and expand can lead to less tight clusters and therefore less pest pressure and cultivation on new nutritious arable land. Both Äppelriket and Kalmar- Ölands trädgårdsprodukter are expanding both in number of producers and areas of cultivation, several of these are situated outside the original cluster. This makes it easier to grow organic since the risk of contaminating soil is small and the crop rotation diseases are less (Börjesson, Lars-Olof, 2013, pers. Comm.).

3.7.5 Porters five forces

The 'Porters five force model' was formulated by the professor, at Harvard University, Michael E. Porter. The model describes the competition on the market for certain businesses (Harvard University, 2013). The five different forces explained in the model describe the keys to the intensity of competition and the pressure at each point that can affect profitability of the business.

By putting all mentioned factors in the report into 'Porters five forces model' the following figure was drawn from current situation;

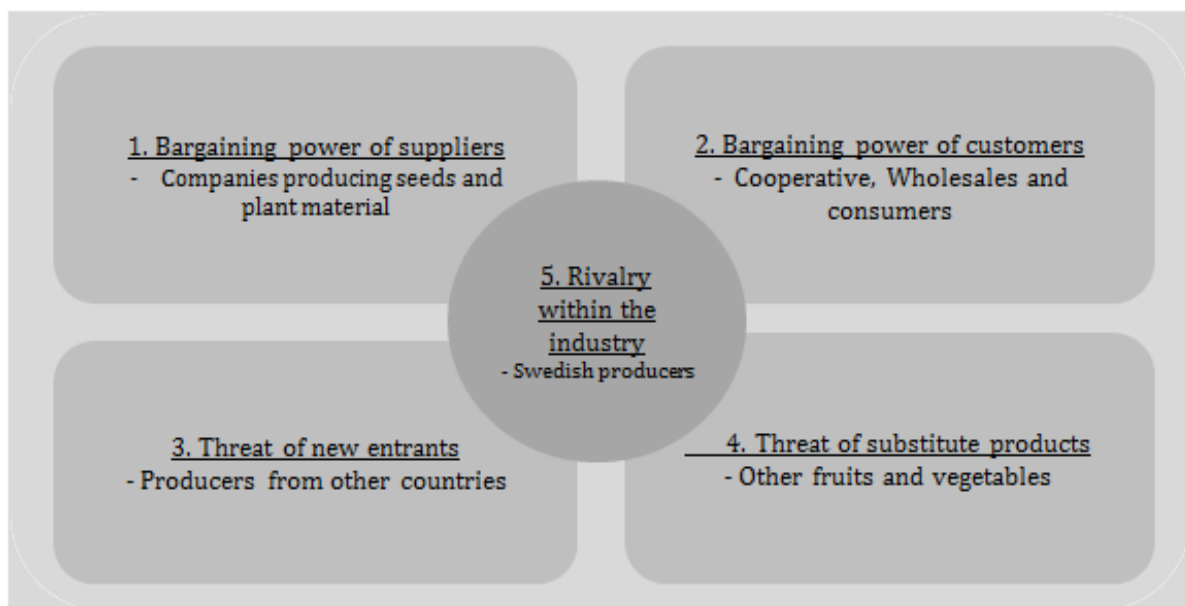


Figure 11: Porters five force model on chosen cultivations in this report.

In the case of bargaining power of suppliers the situation is today quite different from each other in the two cultivations explained in this report. Most of the onion producers buy seeds and the bargaining possibilities are quite low and so is the price (Isaksson, Tomas, 2013, pers. Comm.). If more producers were to produce according to 'horticulture crop rotation' (explained in figure 6) a new market for seedling would appear and the bargaining power of the suppliers could change. The interviewed producers, in this report, using seedlings produced their own and in that case the suppliers continues selling only seeds. When it comes to apples the bargaining power of the suppliers is more relevant. The suppliers are often big nurseries in Holland/Belgium and the possibility for Swedish producers to affect the nurseries in different ways are low. The most important affect, relevant for Swedish

producers, might be the fact that the nurseries should be able to guarantee healthy plant material when deliver. Today that is not the case.

When it comes to the bargaining power of the customers they can be seen both as the co-operatives, the wholesales and the actual consumers. All of them has an impact on the production. In the case of bargaining power against wholesales there are many positive aspects of being a part of a cooperation. The co-operatives, because of their size and amount of produce, are able to negotiate on a good price as the big wholesales prefer one big supplier instead of several small ones. One negative aspect on being a part of a cooperation is the producers' ability to negotiate price with the cooperation. They might get a higher price for their product selling it directly to wholesales but many of the producers interviewed in this report preferred to have someone else do it for them.

The biggest threat for the Swedish producers is the new entrants (Box No: 4) as a result of different restrictions. This affects the other forces as well where price differences on Swedish products compared to others, produced elsewhere, can lead to consumers not willing to pay extra for a Swedish products and the possibility for substitution products appear. According to Sara Ragnarsson (2013, pers. Comm.) on the Swedish Board of Agriculture one problem with Swedish production of onion is that in many cases the consumers are not true to Swedish produce even if the market share today is high. This threat could be the reason that the upcoming restrictions on pesticides are so highly debated.

There are many advantages of being a part of a co-operative if you are a small producer. By having co-operatives the rivalry within the industry, in this case stated as other Swedish producers, can be reduced. Swedish producers see each other as co-workers instead of competitors. Problem can be in the cases where some members can afford investments and equipment needed while others can't.

4. Discussion

4.1 Different conditions provide various opportunities

All industries must change and improve over time along with new innovations, rules and current conditions. Even an industry as basic and traditional as horticulture. The rules for production changes with political decisions and environmental factors. Changes are important to be well understood and implemented in the right way to ensure that the farmers see possibilities and opportunities in the change, a challenge with enormous potential. In many ways decisions coming from higher authorities are less appreciated than decisions coming from authorities closer to the production and the cooperatives. The reason for this might be that closer authorities have better knowledge what local farmers want, need and wish for.

By producing a quality product the producers show great skills and knowledge and are able to show great pride. With incoming changes and new regulations to follow the producers much change and improve and no longer is a long tradition of cultivation the best knowledge to possess. A long tradition can lead to tunnel vision and persistence that in the end can trap the cultivation. They can feel opposed, and instead of looking at the future they only see the past. But as the world changes, the consumer change, the conditions change the producers must also change their mind setting. By doing that they end up more like agriculture entrepreneurs than just farmers. Changes have come before and the producers are more or less adapted to them today. For example when it was decided on that all producers should produce according to integrated production described in the report by Gunnel Larsson (Larsson, 1995) many saw this change as negative and were sceptic. Today, integrated production is an obvious way of producing. It might be the case today as well, the new rules that ban several earlier approved products are in many ways seen as a negative and impossible step but could get as good result as the change into integrated production.

Several of the persons interviewed were not directly sceptic of the fact that less pesticides are approved but more of the fact that it mainly affect the producers in the member states included in the northern zone. The different climate zones are dividing Europe into three and create a gap in opportunities between the zones. The reason for this is not that the climate in the northern zone is not suitable for some of the products but more that the northern zone is not economically favourable for the pesticide producers to invest in. In this case the climate zones, which were seen as an opportunity to harmonize regulations, lost its concept. The

producers in the northern zone feel unfairly treated. The problem is not that they are not allowed to use some product but that others are.

4.2 Alternative ways for approving products, a sustainable future?

Exemptions, parallel approval and off-label approval seem in many ways be the future for chemical pest management on minor crop in Sweden. Because of this, chemical treatments can still be used but with a greater uncertainty. Exemptions are according to Peter Bergkvist (2013, pers. Comm.) at the Swedish chemicals agency not something that should be used frequently as it have been on Merpan 80 WG, which has been approved for exemption for the last 12 years. You would think that this yearly exemption is good for the producers since they are allowed to use it but it is not a product to depend on since the approval must be re considered every year. Instead of depending on approved exemptions, better and more sustainable solutions must be found.

The off-label approval is one opportunity but also this one comes with uncertainty. The problem is in this case that no one takes responsibility if something goes wrong. With no responsibility comes a high economic risk on the producers when using an off-label product. Trials on both selectivity and efficiency to get an approved substance are there for a reason. By only attaching residue trials in the off-label application there are no restrictions on how effective the product actually is and if it can possibly harm the main crop. An off-label is approved for a longer period of time than a yearly exemption but the risk and uncertainty using it in the cultivation might be bigger than for a product approved by exemption.

4.3 “Cultivate what we can and import the rest?”

Most of the persons interviewed agreed that organic farming might be a good competitive strategy when products are banned on the market but not a suitable way of cultivating for everyone. But when products are banned and no other products are available even for a good integrated pest management, other choices must be considered. Swedish producers have for a long time produced according to both integrated production and IPM so compared to others Sweden has come a long way. But now, when new changes stand in the future the Swedish cultivation might be threatened because strict regulations and banned products make it unfavourable to produce. The solution to this is either to come up with a sustainable technique of cultivating without these chemical substances or stop producing crops that more or less need banned products to get a good yield.

Stop cultivating certain crops would force Sweden to import these crops instead. That is not a good solution and just a way of moving the problems outside of Sweden's borders, moving the problems to someone else. Another country that has pesticides available on the market can produce the crops in the same way Sweden did before and no actual change, except for the increased distance in transportation, has been made. This could lead to that less innovation in the area is encouraged and financed since the problem in the short term is solved. At least for Sweden.

4.4 Consumer impact on the market

Swedish consumers have great impact on the market when it comes to preferring Swedish products and staying true to Swedish producers. What the consumer wants must be what the producers deliver. The two crops selected in this report have two different conditions on the market.

Before 1988 Sweden had an 'Import Stop' of foreign fruit during the season when Swedish fruit was fresh on the market, to ensure the income for Swedish fruit producers (Ragnarsson, Sara, 2013, pers. Comm.). This regulation was highly discussed and disliked by other countries and when it was removed Swedish producers were afraid of cheaper competitors on the market and decided on the competitive strategy with high quality.

5. Conclusion

Rules and regulations on pesticides are more frequent today than ever before. European regulations are directly applied into Swedish laws while European directives are implemented into Swedish regulations. The European regulations can be both harmonizing regulations and minimum definitions. By harmonizing rules means that the same rules should be followed in all member states while the minimum definition is just minimum requirements and can be further regulated in every member state. This is where some of the regulations differ. Sweden has a tradition of strict chemical policies and this along with the new climate zones for approval of pesticides has made the rules regarding the active substances chosen in this report to differ between European and Swedish regulations. Active substances are regulated and approved on European level while products must be approved in each climate zone separately. Both Captan and Pendimethalin, the active substances chosen in this report, are up taken in Annex 1 of EU regulation 1107/2009, on approved substances. Both Captan and

Pendimethalin are banned in Sweden. Captan because no application has been sent in and Pendimethalin because of its dangerous properties.

If looking back on the hypothesis stated in the beginning it is so that differences in regulations have in some cases made Swedish producers forced to change and find other solutions to pest problems. In both chosen crops the producers still rely on the fact that the substances are approved annually on exemptions but along with new yearly approved exemptions comes uncertainty for the future. Both the Swedish Board of Agriculture and LRF have taken action in the fact that new chemical strategies and other techniques are required to maintain Swedish production of these minor crops. If those strategies come out well Sweden can find a solution that is suitable for Swedish conditions and rules and thereby maintain a competitive strength on the market. When it comes to new cultivation techniques some new strategies have come up but many of the producers still rely on pesticides. Because of this the future is more going to be the use of off-label approval, products that originally are aimed for another crop, than new alternative ways of cultivating. This is in many cases also what the different ongoing projects aims for both the 'Pesticide Strategy' and the project 'Minor use'. New cultivation strategies to prevent certain pest problems could be a more sustainable way than relying on pesticides with off-label approvals. But new cultivation strategies take time to implement and farmers interviewed in this report believed that chemical treatments are more reliable and easier.

As it looks today the conditions for cultivation differ a lot which in some cases make the situation less favourable for Swedish producers. The main problem does not lay in the fact that certain products are banned but more in the fact that they are not banned everywhere. If everyone were to produce on the same conditions and opportunities within the EU the competition would be more equal and trade within Europe would be based on equal conditions and economic stability.

6. Recommendations

Some improvements can be made on the ongoing problem and below some concrete recommendations are made:

- ➔ Swedish authorities, such as the Swedish Board of Agriculture, together with producers must find more sustainable options for pest management. This both on alternative strategies and new chemical strategies. The production cannot rely on exemptions and off-label approval as this is of highly economic risk and uncertain for the producers. This is mainly the aim of the 'Pesticide strategy' and co-operation between politicians, authorities, chemical companies and producers is needed to succeed.
- ➔ There is a keen interest by the Swedish authorities to keep the Swedish production, both in economic terms and environmental terms. Authorities then need to be better at safeguarding the production. With stricter regulations come greater responsibility. Moving cultivation elsewhere due to banned pesticides would not be to take responsibility for the production but simply to move the problem to someone else. That is not an option if Sweden want to continue being a forefront country when it comes to sustainability and environmental management.
- ➔ Many of the pesticides are banned because no application has been sent in for approval. This is a reaction to the new regulation on dividing Europe into three climate zones. The minor zone, with the minor production, is affected because of the low economic gain for the chemical companies. The climate zones are then more economic zones where Sweden is included in the least profitable one. The EU should consider the side effect of this regulation and make sure that equal rights apply to all.

The recommendations include changes in all steps of the chain, both by the producers and at EU level. If everyone were to react and work towards the same goal, great achievements can be made.

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7.1 Personal Communication

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Börjesson, Lars-Olof (2013) CEO at Äppelriket. Producer Organization for fruit producers.

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8. Appendix, Questionnaire

8.1 Appendix 1

Frågeformulär äppelodlare

Namn:

Företagsnamn:

Odlingsareal:

Typ av jord:

Ungefärlig årlig skörd:

Hur länge har ni producerat äpplen?

Vilken sort/Vilka sorter odlar ni?

Har någon sort upplevts bättre än någon annan?

Under hur lång tid ger äppelträden skörd?

Vart ifrån tar ni in plantmaterial?

Vilken form av bevattningssystem använder ni, när och hur ofta?

Vilka växtskyddsproblem upplever ni?

Hur sker bekämpningen mot fruktträdskräfta?

Om kemisk bekämpning, vilket medel används?

Hur många gånger per säsong sker bekämpningen?

Vad anser ni om prisbilden för svenska äpplen?

Är ni med i någon samordnande ekonomisk förening?

Om ja, inom vilka områden hjälper de er?

Har ni någon form odlingsrådgivning?

Om ja, från vem?

Hur sker er kundkontakt?

Vad är det bästa med att vara äppelodlare?

Vad är det sämsta med att vara äppelodlare?

8.2 Appendix 2

Frågeformulär lökodlare

Namn:

Företagsnamn:

Odlingsareal:

Typ av jord:

Ungefärlig årlig skörd:

Hur länge har ni varit lökodlare?

Vilken sort/Vilka sorter odlar ni?

Har någon sort upplevts bättre än någon annan?

Vilka grödor använder ni i odlingsföljden?

Vilken gröda odlar ni innan lök?

Sådd lök eller sättlök?

Vilken form av bevattningssystem använder ni, när och hur ofta?

Vilka växtskyddsproblem upplever ni?

Hur sker bekämpningen mot ogräs?

Om kemisk bekämpning, vilket medel används?

Hur många gånger per säsong sker bekämpningen?

Vad anser ni om prisbilden för lök?

Är ni med i någon samordnande ekonomisk förening?

Om ja, inom vilka områden hjälper de er?

Har ni någon form odlingsrådgivning?

Om ja, från vem?

Hur sker er kundkontakt?

Vad är det bästa med att vara lökodlare?

Vad är det sämsta med att vara lökodlare?