Bachelorarbete inom Hortonomprogrammet DSH

Heavy metals in organic vegetable production connected to KRAV in the south of Skåne

– accumulation in soil, plant uptake, regulations and health effects

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Foreword

This bachelor thesis is a part of the Danish-Swedish Horticultural Program and correspond 15 ects (10 poäng). The Danish-Swedish Horticultural Program (DSH) is a cooperation between the Swedish Agricultural University (SLU) and the Royal Veterinary and Agricultural Collage (KVL) in Copenhagen, Denmark, that started in 2001. The thesis is a part of a Bachelor degree in Horticulure corresponding 180 ects (120 poäng) and was written for the Department of Landscape Management and Horticultural Technology at Alnarp.

Anybody that has written a thesis knows that it can't be done without help from surrounding people so I want to take this opportunity and express my gratitude to the people that have contributed with their time, help and guidance. I want to thank the four growers that I interviewed for taking time to answer my question tough they were very busy with their spring activities. Many thanks also goes to the KRAV employers that I interview for their good humour and cooperation with contributing with information. A big thank you to my supervisor Angelika Blom for her patience and wisdom with helping me to find the right path with writing the thesis. Another thank you goes to my examiner for the inspiration to write this thesis and his input. Last but not least I want to thank my near and dear that have supported me and listened to all my enthusiasm and worries.

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Summary

Heavy metals are substances that can contaminate our environment and damage our health. If one summarize the addition of heavy metals to the cultivated soil during the 20^{th} century, there can be seen that the content of cadmium has increased with 30%, mercury 45%, lead 15% and other heavy metals with one or a few percent. The aim with this thesis was to investigate how heavy metals are dealt with in organic vegetable production on open field to prevent them from accumulate in the soil and taken up by the plants. Focus was laid upon KRAV, one control-association for organic production in Sweden. Questions were asked if KRAV have any regulations or praxis to keep heavy metals that enter the cultivated soils at a minimum level, and what the KRAV-certified growers are doing to prevent the accumulation of heavy metals. To reach the aim seven interviews were made with four different growers connected to KRAV, two KRAV-controllers and one person responsible for the regulations at KRAV. KRAV have good and quite strict regulations on heavy metals. But from the interviews it showed that the growers who are the ones that should implement these regulations doesn't seem to be particularly aware of heavy metals and what cultural practices they should use to prevent them from accumulate in the soil and taken up by the plants. The interviews with the KRAV-controllers also showed that they have a low prioritizing of controlling the amount of heavy metals that are applied to the cultivated soils by fertilization and that KRAV's regulations on heavy metals are followed by the certified growers. However there were only four interviews done with KRAV-certified growers and they are all localised to Skåne so these results might not accurately reflect on all growers connected to KRAV in Sweden.

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1 Introduction

1.1 Background

If one summarize the addition of heavy metals to the cultivated soil during the 20th century, there can be seen that the content of cadmium has increased with 30%, mercury 45%, lead 15% and other heavy metals with one or a few percent (Pettersson, 1994a).

Heavy metals are substances that can contaminate our environment. Many of them are naturally occurring at low concentrations in the environment. Because of this a small contribution can have significant consequences. Some of the heavy metals are extremely toxic, or in the case of mercury, can be transformed into even more toxic forms. Heavy metals are widely used in industries and are present in many of our daily products. They are also present as contaminations in fossil fuels. Via combustion, industrial release, and waste products they can get an extensive coverage in the environment, both in high concentrations and at a big scale (Pettersson, 1994b).

The classic definition of a metal refers almost exclusively to the physical properties of the elemental state, e.g. ductility and electrical conductivity. Common terms to classify metals in bioenvironmental studies are ‘trace metal’, ‘micro nutrient’ and ‘heavy metal’. The term heavy metal is often used to mean any metal with atomic number >20. Also a definition based on density (i.e., >5-6 g cm^{-3}) is used (Davies, 1980).

Heavy metals are persistent and have ability to bioaccumulate in the flora and fauna. This has made the contamination of heavy metals a great concern in the environment and concerning human health. Some heavy metals, such as zinc and copper, are essential elements for many living creatures and are beneficial in right amounts. Higher amounts of such metals can damage metabolic activities and excessive amounts poison organisms (Kara et al., 2004). Many investigations done in Sweden the resent years have suggested that the population exposure to cadmium is increasing. This is of course alarming since the current exposure is near the level for minor changes in the kidneys function (tubular protein urea) beginning to appear (Bäcklin & Thuvander, 1999). Why the accumulation of heavy metals in the human body is so dangerous is that the only way metals can be eliminated from tissues are by excretion (Clarkson, 1986). Excretion is “the act or process of discharging waste matter from the blood, tissues, or organs”. This is done through urine, faeces or sweat (Stedman's Medical Dictionary, 2002). Accumulation in tissue does not necessarily imply the occurrence of toxic effect since inactive complexes or storage depots are formed in the case of certain metals (Clarkson, 1986).

All of the heavy metals that are accumulated in the human body are mainly retrieved through consumption. Vegetables, root crops, cereals and offal are the ones that the most contribute to the accumulation of cadmium in the human body. For an average consumer one third of the intake of cadmium is retrieved through cereal products and another third through vegetables and root crops (Pettersson, 1994b).

Different production systems can be used in vegetable production. Organic production is one of these production systems. Organically grown, denote that the producer aim for a high degree of self-sufficiency and the use of renewable resources. Chemical pesticides and commercial fertilizers are not used at all in the production. The fertilization is done with natural fertilizers, green manuring, and with nitrogen fixating crops. For provisions to be called ecological within the EU the production must follow EU: s decree of ecological production, 2092/91, from 1991. EU: s regulations are minimum-regulations and over this minimum standard the rules differ from the different member-countries. KRAV, one of the control-association for ecological production in Sweden, have by the Swedish national food administration and the Swedish national board of agriculture been appointed to control organ for ecological products. As well as controlling the ecological production according to EU: s regulations, KRAV also control according to their own regulation system (Jörgensen, 2001).

KRAV:s business idea is to: … work for a sustainable development by making rules for organic production, control that they are followed and inform about the KRAV-lable. We make it possible for our customers to with a high credibility market controlled organic products that stands for, good animal welfare, good health and a social responsibility (KRAV´s-regulation, 2004).

> KRAV´s business idea in Swedish´:
> “*KRAV verkar för en hållbar utveckling genom att ta fram regler*
> *för ekologisk produktion, kontrollera att de efterlevs och*

informera om KRAV-märket. Vi möjliggör för våra kunder att med hög trovärdighet marknadsföra kontrollerade ekologiska produkter som står för, god djuromsorg, god hälsa och socialt ansvar. ”(KRAV´s regulation, 2004)

1.2 Aim

The aim with this bachelor thesis is to see how KRAV relates to the possible accumulation of heavy metals in organically cultivated soils in a health aspect, if they have any regulations or praxis to keep heavy metals that enter the cultivated soils at a minimum level, and what the KRAV-certified growers are doing to prevent the accumulation of heavy metals.

Since EU´s regulations on organic production are the minimum regulations that all EU member states have to follow, these are also looked upon to see if they mention heavy metals. The aim was also to see why it’s not favourable to have heavy metals accumulated in the soils, taken up by the plants and eventually consumed by humans.

1.3 Limitations

The study was narrowed to growers located in the county of Skåne. All of the growers are connected to KRAV and have a production of vegetables or strawberries on open fields. There was no consideration made to the location of the production, gender or age of the grower, and the period of time they have been connected to KRAV.

Limitations were also made by narrowing down the number of heavy metals that are dealt with in this thesis. In KRAV’s regulations lead, cadmium, copper, chrome, mercury, nickel and zinc are referred to as “heavy metals”. In this project focus is lade upon cadmium and lead. This is because these metals can cause health hazards to the humans if consumed with excess, and are the largest problem with heavy metals in agriculture, especially cadmium.

Another limitation was set to only look upon heavy metal as a health risk to humans, not how heavy metals affect plants and animals.

2 Material and method

The investigation started in the spring of 2004 and finished in the spring of 2006 with a complementary interview with a KRAV-controller. Methods used was that a literature review were first made to find information about; why it's not favourable to have heavy metals in the production system and how does the heavy metals accumulate in the cultivated soils. Literature and research results were found from e.g. WebSPIRS databases Agricola, Agris, and CAB Abstracts, the Internet and the library at SLU, Alnarp. Some key words used in the literature search were heavy metals, vegetable production, health effects etc. When the literature review was done the questions fore the growers could be formulated from the knowledge achieved. The interviews were done in a qualitative method with 4 different growers connected to KRAV, two KRAV- controllers, and a central regulation writer at KRAV. The question asked can bee found in Appendix 1.

All of the growers participating in the interviews are situated in the county of Skåne. All of the growers are connected to KRAV and have a production of vegetables on open fields. For the growers discretion they will remain anonymous in this thesis. The controller for KRAV in Skåne was contacted to help find growers, located in Skåne, that had a production of vegetables on open fields. Then they were contacted and asked if they wanted to participate in the project. Since the project was written during the spring the interviews with the growers were mainly performed over the phone. It was only one of the growers that had the time for a personal interview.

When the interviews with the growers were finished it was easier to formulate the questions for the KRAV- controller and one person responsible for the regulations at KRAV (see Appendix 1). These interviews were also made over the phone. When these interviews and the literature review were done, it was found that information about how KRAV prioritized heavy metals, when controlling the growers, was missing. Because of this one more interview were done in the spring of 2006 with a KRAV-controller (see controller no.2). The questions asked can be found in Appendix 1.

3 Accumulation of heavy metals in soil

It is fortunate that most of the heavy metals in the soil is not easily absorbed by the plants and that they are not easily leached from the soil. However this immobility also makes them prone to accumulate in the soil (Brady & Weil, 2002). The accumulation of heavy metals to the cultivated soil during the 20^{th} century summarized, the content of cadmium has increased with 30%, mercury 45%, lead 15% and other heavy metals with one or a few percent (Pettersson, 1994a).

Heavy metals are one of the air pollutions that are transferred by the wind across the country borders (Bringmark, 1999). The soil works as a collector for the metals that are spread through air deposition or by other ways are added to the soil (Pettersson, 1994b). There are many sources from where heavy metals can accumulate in the soil (see *Table 1*), e.g. burning of fossil fuels, smelting, and other processing techniques is released into he atmosphere and can be carried for miles and later deposited on the vegetation and the soil (Brady & Weil, 2002).

Table 1. Sources of selected inorganic soil pollutants (Brady & Weil, 2002; Moolenaar, 1998 & Pettersson, 1994b)

Metal	*Major uses and sources of soil contamination*
Cadmium	Electro plating, pigments for plastics and paints, plastic stabilizers, batteries and phosphate fertilizers
Chromium	Stainless steel, chrome plated metals, pigments, refractory brick manufacturer, and leather tanning
Copper	Mine tailings, fly ash, wind-blown copper containing dust, water pipes, fertilizers and copper-containing fungicidal sprays
Lead	Combustion of oil, gasoline, and coal; iron and steel production; solder in water pipes; paint pigment and seed disinfectants
Mercury	Catalysts for synthetic polymers, metallurgy, thermometers and pesticides
Nickel	Combustion of coal, gasoline, and oil; alloy manufacture; electroplating; batteries; and mining
Zinc	Galvanized iron and steel, alloys, batteries, brass, rubber manufacture, mining and old tires

In Sweden there is a significant variation in the amount of heavy metals in the south of Sweden and in the north of Sweden, being high in the south and low in the north. This points to that pollutions from other countries can be transported long distances with the wind (Bergbäck, 1996). Lead is one of the heavy metals which main source of accumulation in soil is by air deposition (Pettersson, 1994b).

Other ways of heavy metals to accumulating in the cultivated soil can be through farmyard manure. This is because of the mineral fodder that is given to the animals or the oxidation of the stable interior (Eriksson, 1992 & Andersson 1999). The consequence is an excess supply compare to the withdrawal of the yield at the same area (Andersson, 1999).

4 Plant uptake of heavy metals

4.1 Physiology

Different plant species has different ability to take up heavy metals, even within the same species you can find differences between cultivars. In table 2 the content of cadmium in different plant species can be seen. (Pettersson, 1994b).

Table 2. Normal occurring cadmium-content, µg/kg dry matter, in different plant species (Pettersson, 1994b)

Plant species	*Average cadmium content µg/kg DM*
Salad	8
Carrot	22
Potato	17
Apple	<1
Strawberries	8
Sunflower seeds, peeled	380
Autumn wheat	60
Oat	40
Barley	20
Rye	15

One factor of heavy metal uptake by he plants is the distance the metal is transported in the plant. To take cadmium as an example; as cadmium is transported through the plant it is left in the transportation route. How this is reflected in the final content can bee seen in *figure 1*. (Pettersson, 1994b).

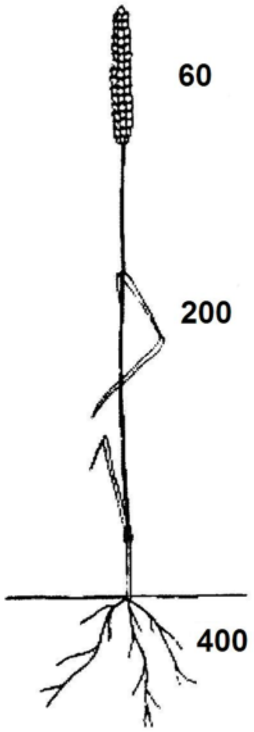

Figure 1. The approximate amounts of cadmium, mg/kg dry matter, in different parts of a wheat plant (Pettersson, 1994b).

The type of tissue that dominates the edible parts of the plant is also of significance. The grain shell has normally higher amounts of heavy metal than the grained flower. The root of a plant contains higher amounts than the stem, which has higher amount than leaves and fruits. Fruits have generally low amounts of heavy metals if they not have been contaminated through air deposition (Pettersson, 1994b).

As plants take up essential nutrients, such as nitrogen, phosphorous and potassium, they also accumulate metals such as lead and cadmium (Ismail, 2005). Cadmium has some similarities with Zn, and is able to mimic Zn that is an essential element. Because of this ability can cadmium replace Zn in the uptake and metabolic functions of the plant (Moolenaar, 1998).

4.1.1 Cadmium/zinc quota

Cadmium and zinc are mutually antagonistic when taken up by the plant roots. This means that the plants take up less cadmium if the zinc content is high (Eriksson, 1990). Chaney & Ryan (1994) state 70 mg Cd kg^{-1} DM as a guideline for determining the risk of to high values of Cd in the food-chain in a protection perspective. According to the authors this amount cannot be take up by the plant no matter how high the Cd-content is in the soil, if the Cd/Zn quota is lower than 0,015. Even if a low quota is sustained still the Cd-uptake in the crop increases generally with the amount of cadmium in the soil, but if the zinc-content increases at the same amount the risk of the cadmium level reaching toxic levels in the crop is demolished. In Sweden the risk of getting a Cd/Zn quota lower than 0,015 is very small since the soils generally have a higher quota (Eriksson et al, 1996).

4.2 Soil composition

Plants ability to take up heavy metals is sharply correlated to the free metal ion activity or solubility in the soil (McBride, 2002). In a study made by François et al. (2003) they found that areas with similar contents of heavy metals hade different solubility values, suggesting that heavy metal solubility is dependent on soil properties rather than the total content of heavy metals in the soil. Factors that influence the bioavailability are the soils pH, soil texture, mineralogy and organic matter content (McBride, 2002).

4.2.1 pH

The soils pH is the main factor affecting the mobility and bioavailability of heavy metals (Ismail et al., 2005). Most of the heavy metals are rendered less mobile and less available for plants to take up if the pH of the soil is kept near neutral or above. At these pH levels the heavy metals are generally bound to soil elements and are not easily available to the plants. The lower the pH of the soil the smaller the adsorption of heavy metals is, making them more soluble. This is however not true for hexavalent chromium which is soluble in a wide range of pH conditions (Brady & Weil, 2002). Soils with generally high pH values are soils with high lime content. Low pH values are generally connected to large granulated soils, high amounts of precipitation and high contents of humus (Ericsson et al, 1997).

4.2.2 Soil texture

Soils containing smaller particles have the ability to bind heavy metals better than soils with larger particles. This renders the clay soils to accumulate more heavy metals than sandy soils. However the heavy metals in the sandy soils are more soluble and therefore more available to the plants. In sandy soils it is mainly the humus content that binds the metals[1].

[1] **Eriksson, J**. **(2006)** universitetslekor på instutionen för Markvetenskap, SLU, Ultuna. Personal communication 2006-05-18

4.2.3 Mineralogy

The amount of heavy metals present in the soil is but to contamination from outer sources also correlated with the original material of the soil. For example, the highest concentrations of cadmium can be found in areas with a high amount of alum shale in the soil. High amounts of heavy metals in the plough layer is often correlated with high amounts in the subsoil, this indicates that the original material of the soil determines the geographic patterns in the plough layer. Mercury on the other hand, is strongly bound to organic material and there by show a strong correlation with the content of humus in the soil. (Eriksson et al, 1997).

4.2.4 Organic Matter

Organic matter makes strong complexes with heavy metals. Solid organic matter is for example able to hold metals in the solid phase of the soil. As organic materials influence the binding of heavy metals in soil, it may also affect plant uptake (Arnesen & Singh, 1998). Active solid organic matter is also quite effective in reducing the soluble and toxic hexavalent chromium (CrVI) to the more stable and less toxic form of trivalent chromium (CrIII) (Brady & Weil, 2002). However amendment with organic matter may change the soil pH to more acid and thereby indirect influence the bioavailability of metals to be more prone (Arnesen & Singh, 1998). In a study made by Arnesen and Singh (1998) they found that metals that bound to the organic matter the first year it was applied to soil were probably released as the organic matter decomposed in the following years. They also fund that for some metals such as copper and zinc, application of organic matter may even have increased their plant availability. In some soils such as peat soil the application of organic matter does not seem to reduce the plant availability of heavy metals.

5 The effect of heavy metals on the human body

5.1 Copper

Copper is an essential element to all living organisms, and because of that both deficiency and excess have consequence for the integrity of biochemical functions. The main biological role of copper is as an ingredient, normally in the prosthetic group, of oxidising enzymes which are important in oxidation-reduction processes (Moolenaar, 1998).

Copper is highly toxic when in excess (de Bie et al., 2005). Even small amounts of copper, such as the dose contained in drinking water, could lead to toxic effects. These small amounts of copper can cause nausea (Hotz et al., 2003). When copper is consumed in excess it can have a variety of symptoms such as mental diseases, learning disabilities, behaviour problems, tiredness, muscle and joint pain, irritability, depression, nervousness and fatigue. It has also been found that premature wrinkling of the skin is related to excess consumption of copper (Campbell, 2001).

Copper deficiency on the other hand may contribute to week blood vessels (aneurism), an enlarged heart, elevated cholesterol, gout, hyperactivity, emotional disturbance and depressed dopamine levels. A shortage of dopamine may result in defects related to multiple sclerosis (MS) and Parkinson's disease (Campbell, 2001). Copper deficiency can also cause an iron-deficiency-type of anaemia (Aaseth & Norseth, 1986).

5.2 Chromium

Chromium is an essential nutrient to the human body as it is required to promote the action of insulin for the utilization of sugars, proteins and fats. Chromium is a naturally occurring heavy metal that is found in the environment as trivalent, Cr(III) and hexavalent, Cr(VI) forms, where Cr(VI) is responsible for most of the toxic actions (Shrivastava et al., 2002).

A high dose of chromium and long term exposure can give rise to various, cytotoxic and genotoxic reactions that affect the immune system and may result in immuno-stimulation or immuno-suppression. Occupational exposure to chromium is manly through inhalation and non-occupational exposure is mainly through consumption. Chromium is very toxic when inhaled and causes lung cancer, nasal irritation, nasal ulcer, hypersensitivity reactions and contact dermatitis. When chromium is ingested its mainly Cr(VI) that is toxic, although not as toxic as through inhalation. When Cr(VI) is digested it is reduced to Cr(III) before entering the blood stream. The reduction of Cr(VI) to Cr(III) results in the formation of reactive intermediates that together with oxidative stress and oxidative tissue damage and a number of other molecular events contribute to the cytotoxicity, genotoxicity and carcinogenicity of Cr(VI)-containing compounds (Shrivastava et al., 2002).

Chromium salts, chromium polynicotinate, chromium chloride and chromium picolinate (CrP) are used as micronutrients and nutritional supplements and have been demonstrated to possess a number of health benefits to humans and animals. CrP for example have been used as a nutritional supplement to control blood sugar in diabetes patients and it may also reduce cholesterol and blood pressure levels (Shrivastava et al., 2002).

The general non-occupational exposure of the population to chromium is from food such as vegetables and meat. Other ways of non-occupational exposure is through urban air, hip or knee prostheses and cigarettes (Shrivastava et al., 2002).

5.3 Zinc

Zinc is an essential nutrient for the human body and has an importance for health (Hotz et al., 2003). Zinc acts as a catalytic or structural component in many enzymes that are involved in energy metabolism and in transcription and translation of RNA (Moolenaar, 1998).

Deficiency symptoms in humans and animals are failure to growth, loss of apetite, acne, slow healing, strong body and breath odour, and a decrease in taste perception (Campbell, 2001) Zinc also has a prominent role in determining the outcome of pregnancies and supporting neurobehavioral development (Hotz et al., 2003). Zinc deficiency is also closely correlated to optimum blood circulation and cardiovascular disease (Campbell, 2001). There is a lot of information available on zinc deficiency; however there is relatively little information on toxic effects caused by zinc excess (Hotz et al., 2003)

5.4 Nickel

Since nickel is not proven to be an essential element in humans it is not clear how nickel compounds are metabolized in the body. It is however known that over exposure to nickel compounds may have an adverse effect on human health. The most common and well known reaction of nickel on humans is contact-allergy. Nickel can also be accumulated in the body through chronic exposure, which can cause lung fibrosis and cardiovascular- and kidney diseases. However the most serious concern is nickel's carcinogenic effect and its ability to induce tumours at nearly any site of administration (Denkhaus & Salnikow, 2002).

The primarily exposure of the population to nickel is via inhalation and ingestion. Some vegetables such as spinach contain high amounts of nickel. Other dietary exposure to nickel is through cocoa and nuts which also contain high amounts. It is however very difficult to maintain a nickel-deficient diet since it is present in all types of food (Denkhaus & Salnikow, 2002).

5.5 Mercury

There are three forms of mercury and among these the most toxic one is the organic form, methyl mercury. Methyl mercury is microbiologically transformed from inorganic mercury when it reaches aquatic environments, in water bodies or in soils (Zahir et al., 2005).

Inorganic- and organic mercury is toxic to the human body in different ways, effecting different organs in different ways. Inorganic mercury can cause neurological and psychological symptoms, such as tremor, changes in personality, restlessness, anxiety, sleep disturbance and depression. These symptoms are however reversible after ending of exposure to inorganic mercury. Inorganic mercury is also an allergen, which may cause contact eczema. The kidneys are the organs that accumulate the highest levels of mercury compared to brain and liver. This can cause kidney damage which is reversible after the exposure has stopped. Organic mercury, methyl mercury, toxicity is not reversible as it is with inorganic mercury. Organic mercury affects the nervous system and the main symptoms of methyl mercury poisoning relate to damage of the nervous system. The earliest symptoms of poisoning are parestesias and numbness in the hands and feet. Later symptoms are coordination difficulties and concentric constriction of the visual field (Järup, 2003). Other symptoms are memory loss, shortfall in attention and Alzheimer's disease like dementia (Zahir et al., 2005). Hock et al. (1998) made a study on if environmental factors may influence the risk of getting Alzheimer's disease. They found that Alzheimer's disease patients had a two-fold higher blood-mercury level than the control group and that early onset Alzheimer's disease patients, blood-mercury levels where three-fold higher than the control group. Exposure to the foetus of humans to mercury can also cause late development of speech, late walking, memory shortfall in attention and Autism (Zahir et al., 2005)

The general population is primarily exposed to mercury via food, where fish is the major source of methyl mercury exposure (Järup, 2003). However some vegetables have been found to be able to accumulate mercury at significant levels, such as *Bracica oleracea* and *Amaranthus oleraceous* (Zahir et al., 2005).

5.6 Lead

Lead is toxic because it mimics many aspects of the metabolic behaviour of calcium and inhibits many enzyme systems. In man, one of the chief concerns in lead toxicity is its effect in causing brain damage particularly to children (Tsuchiya, 1986). Children are very susceptible to lead exposure (Järup, 2003). Some chronic effects are related to the haematopoietic system (anaemia), the nervous system (encephalopathy), gastrointestinal tract (stomach complaints etc) and the kidneys (renal tubular dysfunction) (Tsuchiya, 1986).

The general exposure to lead is from air and food in more or less equal proportions (Järup, 2003). There are few reports on lead induced toxic effects on plant growth in natural ecosystems that have been severely polluted with lead (Koeppe, 1981). This is because lead is consequently unavailable to plants (Brady & Weil, 2002). The more significant role of plants with Pb in the ecosystem resides in the food chain, where deposition of lead on the leaf surface may be ingested by herbivores (Koeppe, 1981).

5.7 Cadmium

Cadmium is toxic because it has some similarities with zinc that is an essential element. Because of this, cadmium have the ability to mimic zinc in some metabolic functions, but unlike zinc there has been no evidence that cadmium is essential to any metabolic function. Instead cadmium has the ability to disturb enzyme activity in the body (Moolenaar, 1998). In a study done by Järup & Carlsson (1999) it showed that exposure to cadmium was connected to damage on the kidneys as well as kidney stone (renal calculus). Cadmium is probably also carcinogenic to humans. At long-term exposure to high cadmium levels, cadmium may cause skeletal damage (osteoporosis and osteomalacia) (Järup, 2003).

Many investigations done in Sweden the resent years have suggested that the population exposure to cadmium is increasing. This is of course alarming since the current exposure is near the level for minor changes in the kidneys function begin to appear (tubular protein urea) (Bäcklin & Thuvander, 1999). Adequate levels of essential elements especially zinc and vitamin C reduces abortion and excretion of cadmium (Campbell, 2001).

Vegetables, root crops, cereals and offal are the foods that the most contribute to the accumulation of cadmium in the human body. For an average consumer one third of the intake of cadmium is retrieved through cereal products and another third through vegetables and root crops (Pettersson, 1994b).

6 Regulations for organic vegetable production

6.1 EU´s regulations

EU´s regulations on organic production are minimum regulations that every producer of organic produce in the European Union is required to follow (Jordbruksverket, 2003). A country has therefore not the right to ask ´more`, than the regulations says, of the producers that are only certified from EU's regulation system. These producers have the right to mark their products with "organic" (Wivstad et al., 2004). The regulations is composed by a number of regulations that have been decided by EU´s ministry and respective council. Regulation (EEC 2092/91) was emitted in 1991 and since then a number of amendments have been made (Jordbruksverket, 2003).

In Sweden it is the central government authorities, the Swedish board of agriculture (Jordbruksverket) and the National Food Administration (Livsmedelsverket), that have the responsibility to see that the organic producers are following the rules in EU´s regulation of organic production. KRAV is the certifying and controlling organ of the regulations (Jordbruksverket, 2003).

6.1.1 What is said about heavy metals in EU´s regulations on organic production?

In EU´s regulations there is a list of allowed fertilizers and soil improvements. In the list the products that are allowed are described with demands on composition and stipulation for usage of them. Four of the products have upper limit values set out for their content of heavy metals. *Table 3* shows this list shortened to only the products that have limits on heavy metal content set for them.

Table 3. Example of allowed fertilizers and soil improvements in organic production (Jordbruksverket, 2003)

Name of product	*Description/ demands on composition/ stipulation for usage*
Composted or fermented Household waste	The demand should be established by the controlling organ. Product from source separated household waste that has been composted or treated through anaerobic fermentation for bio-gas production. Only vegetable or animal household waste. Produced in a closed and supervised collection system that is approved by the Swedish board of agriculture. The highest approved concentration in mg/kg dry matter: cadmium 0,7; copper 70; nickel 25; lead 45; zinc 200; mercury 0,4; chrome (total) 70; chrome (VI) 0.
Products or by-products from animal origin as follows: Blod meal, hoof meal , horn meal, bone meal, fish meal, beef meal, feather meal, hair meal, chquett meal, wool, fur, hair and milk-products	The demand should be established by the controlling organ. For fur the highest approved content in mg/kg dry matter: chrome (VI) 0.
Raw phosphates	Are not approved to contain more cadmium than 90 mg/kg P_2O_5.
Aluminium-calcium phosphate	Are not approved to contain more cadmium than 90 mg/kg P_2O_5. Is only allowed to use on soils which pH >7,5

EU:s regulations on organic production allows copper in the form of copper-hydroxide, copper-oxichloride, (tribasic) copper-sulphate or oxides of copper substances to be used as a fungicide, if demand is established by the controlling organ. The amount of copper is limited to hectare and year (Jordbuksverket, 2003).

6.2 KRAV´s regulations

KRAV is an incorporated economic association that was founded in 1985 by represents in the Swedish organic farming movement. KRAV´s regulations on organic production have been adapted to IFOAM Basic Standards and EU´s regulation (EEC 2092/91) on organic production. IFOAM stands for the International Federation of Organic Agricultural Movements and is an umbrella organisation for organic production, with members in over hundred countries. IFOAM Basic standards are rules that should build the base for the national organisations regulation system.

KRAV´s regulations have also been formed together with many different actors within the Swedish organic production (Wivstad et al., 2004).

6.2.1 What is said about heavy metals in KRAV´s regulations?

Heavy metals are directly mentioned in five paragraphs in KRAV´s regulations; sanctions for when rules are not followed, §2.9.5; contaminations, §4.2.1, §4.2.2 and §4.2.5; fertilizers and soil improvement materials, §4.3.7. The full content of these paragraphs can be seen in Appendix 2.

KRAV holds the authority to make sanctions, disapproval, and notice of cancellation or enclosure of contract with farmers connected to KRAV if the products they produce contain high amounts of heavy metals. KRAV also has the power to fail a cultivated area if to high remainders of heavy metals are present (KRAV, 2004).

The input of heavy metals to the cultivated soil should be limited. The highest permitted average input during a five-year period of heavy metals with contributed fertilisers, soil improvement material, pesticides and other products which sooner or later is furnished to the soil (i.e. fodder, fodder-minerals and medicines) is show in table 4. When a number of products are delivered to the soil the amounts should be added together (KRAV, 2004).

Table 4. The highest average contribution of heavy metals permitted to be applied through soil amendments or other sources to the cultivated soil, during a five year period (KRAV, 2004)

Heavy metal	***g/ha and year***
Lead	50
Cadmium	0,75
Copper	500
Chromium	50
Mercury	1
Nickel	50
Zinc	700

The KRAV regulations states that imported fertilisers and soil-improvement material should be analysed of its content of heavy metals when there is reason to assume that the values can be high. This is always current for leftover products from industry and metabolic waste, i.e. ash, slag and industrial lime (KRAV, 2004).

Cultivation and storage of products should be placed so pollutants don't lower the KRAV-approved products value as provisions or fodder. Cultivated soils that are situated within 25 meters from a road, where the traffic intensity is above average 3000 vehicles a day counted over the year, is not allowed to be used for crops meant for human consumption. Seeds are not allowed to be treated with chemical pesticides or fungicides (KRAV, 2004).

From 2004 will KRAV gradually establish demands that all companies connected to KRAV shall have environmental management system for the connected production. As a basis for this environmental management system the first step will include a plant nutrient balance, soil survey and a crop production plan[2]

[2] Regulation responsible at KRAV, 2004

7 Interviews with KRAV-associates

7.1 Interviews with growers

7.1.1 Grower 1

The production on the farm changed from conventional to organic in 1996. There is no animal production on the farm, only vegetables and strawberries. The crops that are cultivated are mostly strawberries (Zefyr and Corona), vegetables, and potatoes. The cultivated area is 5 ha where one ha is green manure each year. The soil structure is mainly light but there is some variation because of the hilly landscape and some part has a slightly more heavy soil.

The crop rotation is 6 years and made by help from a counsellor. The area is separated into 12-14 blocks, and each block has different crops.
The crop rotation is:
year 1-3(-4) strawberries
year 4 green manure
year 5 potatoes and vegetables, the vegetables are combined depending on their root depth.
Because there is only one-soil type, different crop sequences are not needed.

Binadan, that is a commercial fertilizer for organic growers, is the only fertilizer that is used except for the green manure. Binadan is placed by hand in the rows of the root crops and if needed to the other vegetables. The strawberry Corona is fertilized with Binadan at plantation and then again after 2 years. Totally the amount of Binadan spread is 3-4 tons each year on about half of the cultivated area, i.e. 2,5 ha. The fertilization is done without a fertilizing plan for each crop. Neither a nutrient balance nor a heavy metal balance (e.g. for cadmium) is done for the crops.

They made a soil survey 6 years ago and are planning to do one this year again. The last time the soil survey was done the amount of nutrition in the soil was ok as he remembered and the pH was between 7,4-7,9. No analysis of the subsoil has been done. There has not been any analysis done over the content of heavy metal in the soil, neither in the plough layer nor in the subsoil. The actions, that are done to prevent accumulation of heavy metals in the soil so that they don't exceed the limits that KRAV has decided, are none. But because they don't use any commercial, non organic, fertilizers they haven't found heavy metals to be anything to worry about.

7.1.2 Grower 2

The farm is from the beginning an old market garden since 1905. The production changed to organic production in 1988 and was connected to KRAV at the same time, when the current owner bought it. The production today is different types of vegetables and root crops. No animal production is present. The cultivated area is 1 ha, where 7000-8000 m^2 are vegetables and root crops and the rest is green manuring. The soil on the cultivated area is light clay with a lot of sand and a small amount of humus. He explains the crop sequence as flowing and tries to vary the crops as much as possible depending on the amount of weeds that is present and his knowledge of the different crops.

Green manuring consisting of perser-clover, home made compost with remaining plant parts, purchased KRAV-certified pelletized chicken manure, composted cow dung from Simontorp, and Algomin are the fertilizers used in the production. The amount given of each fertilizer differs a lot depending on the previous crop. The grower cannot say exactly how much of each product he uses per hectare and year, only that he consumes about 3 – 4 pallets a year of composted cow-dung from Simontorp and that he looks at each crop to se how much fertilizer that is needed.

The fertilizing is done without a fertilizing plan for each crop. He ploughs the field in the spring to prevent leakage of nutrients. Neither is a plant nutrition balance nor a heavy metal balance done on any of the crops.

A soil survey was done when he bought the market garden and has been done ever since, every 5th to 8th year. He has also made a spurway-analysis once. At the last time a soil survey was done the pH was around 7. No soil survey has been done in the subsoil. There have neither been any analyses of heavy metals in the plough layer nor the subsoil.

The actions, that are done to prevent accumulation of heavy metals in the soil so that they don't exceed the limits that KRAV has decided, are none. He hasn't got any alarming information on that the fertilizers that he uses could contain a lot of cadmium.

7.1.3 Grower 3

The production was changed to organic growing in 1983 and is today connected to KRAV. The production is fresh herbs and vegetables that are driven in a glass house and after that planted out on the field. 60-70 different vegetables are grown where leek is the largest crop. The farm has no animal production. The cultivated area is 3500 m^2 on which all of the area is cultivated, no green manuring. The cultivated soil is heavy, stiff clay. To get higher humus content in the soil all top residues, lawnmower residues, and leaves are mowed down in the autumn. Because there is a lack of land area, and the high amount of onions grown there is a problem with maintaining a crop rotation is minimal. Therefore there is a minimal crop rotation on the farm.

For fertilization 10m^3 liquid manure is spread evenly over the cultivated area. The liquid manure is retrieved from a closely located farmer that has conventional milk production. The fertilization is done without a fertilizing plan for each crop. Neither a plant nutrition balance nor a heavy metal balance (e.g. for cadmium) is done.

There has been done no type of analysis of the soil, no soil survey and no analysis of heavy metals. The actions, that are done to prevent accumulation of heavy metals in the soil, so that they don't exceed the limits that KRAV has decided, are none.

7.1.4 Grower 4

1987 the farm started to convert to organic farming. Since then it has preceded step wise and in 2002 all of the area was converted into organic farming. The total cultivated area is 50 ha on that area 5 ha is for vegetable and potato cultivation. On the rest of the area pasture is grown as fodder for the sheep. The farm has animal production with 100 ewes that lamb each year, the lambs then goes to a butcher for meat. The 5 ha of soil where the vegetables and potatoes are grown; 1ha vegetables and 1 ha potatoes are grow each year, the rest of the area is green manuring. The soil structure is a light sandy soil with a small amount of stones.

They have a crop rotation of four years.
year 1 pasture 1, the pasture is used as primer grassing ground for the lambs
2 pasture 2
3 vegetables, 30-40 different species are grown and they rotate the crop so the same crop doesn't come back to the same cultivation area until after 10 years.
4 potatoes

Composted solid manure from the sheep is used as fertilization for the vegetables. About 80 tons a year is placed on the 5 ha that is included in the crop rotation for the vegetables. The fertilization is done without a fertilizing plan for each crop. Neither a plant nutrition balance nor a heavy metal balance (e.g. for cadmium) is done. They made a soil survey 5 years ago on the plough layer and plan to do one again this year. There has never been taking a soil survey on the subsoil. An analysis of heavy metals in the soil was done ones, when Findus made tests for if they could use the land for crops to their baby food. The result was that the value of heavy metal was not alarming.

The actions, that are done to prevent accumulation of heavy metals in the soil so that they don't exceed the limits that KRAV has decided, are none.

7.2 Interview with KRAV- controllers

7.2.1 KRAV-controller 1

To check if the regulations concerning fertilizer- and heavy metal balances are followed by the growers, a form is sent out to all the growers every year. In this form the growers have to fill in which fertilizers they use, how much, and when. KRAV has done a risk assessment on fertilizers that are known to contain a high amount of heavy metals, e.g. ash. In the form there is a special column that asks the grower if they use ash as fertilizer. If the answer is yes there is a following question where the grower has to enclose an analysis of heavy metals in the ash that were used. There is no analysis done on farmyard manure, but all other fertilizers that are marked with the KRAV symbol are analyzed for heavy metals and with the packaging follow a description over the maximum amount fertilizer per hectare concerning N, P, K, and heavy metals. KRAV doesn't do any balancing calculations on heavy metals from the information on which fertilizers are used and the amount used.

According to KRAV´s regulation §4.2.5 on contamiation, 2004, it is not allowed to have a larger input of heavy metals during a five year period than those limits put down in table 4. To control this the KRAV- controller alarms the farmer if he/she has bought in too much of a product with high amounts of heavy metals and then makes a notation of it that is followed up the next year. There is not done any routine analysis on cultivated soils concerning heavy metals.

For checking products content of heavy metals in vegetables, KRAV rely on the Swedish national food administrations random sample taking on groceries. The reason for this is that it is very expensive to do an analysis on heavy metals. During the five years the controller has worked in the region of Halland and Skåne, none of the growers have been disapproved with relation to KRAV´s regulations on heavy metals.

7.2.2 KRAV-controller 2

The environmental management system that was going to be implemented, starting gradually in 2004, is still in its cradle. There is however a proposal to make it compulsory with a plant nutrient plan for all growers but it has not been implemented yet.

KRAV's regulations state that all of the applied fertilizers content of nutrients and heavy metals should be added together. In practice the controller only looks on the fertilizers that are known to contain high amounts of heavy metals or are suspected to contain high amounts of heavy metals. All other fertilizers aren't as critically and thoroughly revised.

When new land is put under qualifying period for certification under KRAV there's made a soil survey. In these investigations some cultivated soils have been disapproved for containing to high amounts of heavy metals. These disapprovals were made in the start of KRAV. No disapprovals have been made because of to high amounts of heavy metals in resent years, at least not of the knowledge of the controller.

Heavy metals are not prioritized in the controlling of KRAV's regulations. The controlling of heavy metals in the cultivated soils is based on risk assessment. When there is reason to believe that there can be too high amounts of heavy metals in the soil or in the fertilizer, a more thoroughly investigation is done, with demands on heavy metal analysis. When it have been established that there is a risk of too high amounts of heavy metals in the cultivated soils an effort is done to prevent or control. The cultivated soils are not analyzed regularly for their contents of heavy metals.

7.3 Regulation responsible at KRAV

According to KRAV´s regulation §4.2.5 on contamiation, 2004, it is not allowed to have a larger input of heavy metals during a five year period than those limits put down in table 4. These limits are based on the Swedish national food administrations limits on when the plants starts to take up dangerous quantities of heavy metals through the roots.

”A cultivated area can be disqualified if the presence of heavy metal is too high”, this is written in KRAV´s regulation §4.2.2, 2004. KRAV has no clear limits on which contents of heavy metals in the soil is reason for disqualification of a cultivated area. The decision of disqualification of a cultivated area are based on an investigation that is done if there are any reasons to think that the soil could be contaminated with pesticide residues (e.g. DDT) or high values of heavy metals (e.g. an old industrial property). In the investigation to see if a suspected area should be disqualified the national food administration and the national environment protection board is consulted. Questions that are asked are; is the substance tied to the soil particles and how big a risk is it that the crop will take up the substance with the roots?

To control that KRAV´s regulation concerning heavy metals is followed, all imported fertilizers to the farm that has the KRAV logo are analyzed on their content of heavy metals and all industrial leftovers that are used as fertilizers are also tested.

8 Discussion

It is impossible to keep the soil and vegetables totally free from heavy metals. Some of the heavy metals that are dealt with in this thesis are essential to us (copper, chromium and zinc), and we need them in our diet to not get deficiency symptoms. These metals are only toxic when consumed in excess but then they can do great harm to our health. The rest of the heavy metals that are dealt with in this thesis (cadmium, lead, mercury and nickel) haven't been proven to be essential to us but proven to be toxic if consumed in excess. All heavy metals that we consume are accumulated in our body and can only be aborted from our bodies by excretion. This makes it important that our daily intake isn't too high.

There are two regulation systems that can be followed by a producer in Sweden that want to produce organic vegetables. By following EU's regulations the grower is allowed to mark his/her vegetables with "organic" and by being certified by KRAV and following their reglations he/she is allowed to put the KRAV brand on their products. These regulations differ at some points and in this thesis both of the regulations have been looked upon concerning heavy metals. However the focus has been laid upon KRAV and therefore interviews were only made with KRAV associates.

In EU´s regulation on organic vegetable production, are the minimum regulations for organic produce. In their regulations not much is said about heavy metals. They are only mentioned in highest allowed contained limits in some products that can be used as fertilizers and not any cultural practices to avoid heavy metals to accumulating in the cultivated soils. This can however be misleading since not the whole of EU's regulations on organic production have been investigated. It was very difficult to find EU´s regulation (EEC 2092/91) in a complete version with all amendments, so the regulation that has been investigated in this thesis is a summarized version done by the Swedish Board of Agriculture in 2004. By doing this some information in the regulations might have been missed.

KRAV has quite strict regulations on heavy metals, but are they working effectively after these rules and are the farmers aware of heavy metals and what are they doing in praxis to prevent them from accumulating in the soils? This was one of the questions asked in this thesis.

By setting limits of allowed contribution of heavy metals through fertilizers and other products that sooner or later are delivered to the soil and setting the limit of distance to heavily trafficked roads, KRAV regulations work on preventing heavy metals to accumulate in the soil and finally be taken up by the plants. The regulations on disapproval if the soil or produce contain to high amounts of heavy metals, also works at preventing heavy metals to accumulate in the plants and by that keeping the heavy metals from human consumption. The decision on disapproving a cultivated soil is based on a risk assessment where KRAV asks the questions: is the substance tied to the soil particles and how big the risk is that the crop will take up the substance with the roots? These are valid question since the plant availability of heavy metals is dominated by different features to the soil, such as pH, mineralogy, soil texture and organic matter content. For cadmium it is also dominated by the cadmium/ zinc quota. I think that by doing a risk assessment KRAV gets a more truthful answer on if the heavy metals in the soil are available to be taken up by the plants than if only a test on the content of heavy metals in the soil was made. KRAV's regulations don't however say anything on cultural practices that can be done to prevent plants to take up heavy metals. There are several soil- and plant properties that effect the amount of heavy metals to be taken up by the plants. A way of controlling that heavy metals don't get taken up by the plants can be by prevention in the cultural practices;

- by keeping the pH at neutral or above;
- by application of organic matter to the soil;
- by keeping the cadmium/zinc quota lower than 0,015;
- by not growing plants that easily take up and accumulate heavy metals in the edible parts, on soils that are known to contain high amounts of heavy metals.

Above I have discussed KRAV's regulations, so what do the certified growers do to implement them and how do the KRAV-controller control that the regulations are followed? In the interviews that were made with the growers they couldn't answer precisely on how much fertilizer they used on the cultivated area each year but only gave a vague amount. This could be because the interviews were made over the phone and the growers didn't have the figures in their heads or because they didn't know. But if the growers don't know precisely how much fertilizer they use on the cultivated area it makes it very difficult for KRAV to make an accurate evaluation, from the form that is sent to the growers, on the risks of the limits for heavy metals being exceeded. From the interview with KRAV-controller number two the answer on how they prioritized to control heavy metals was that in practice the controller only looks on the fertilizers that are known to contain high amounts of heavy metals and rarely make calculations on the total input of heavy metals by different fertilizer based on the form the growers have to fill in and send to KRAV.

The growers also didn't take any conscious actions so that the contribution of heavy metals wouldn't exceed KRAV's limits. None of the four growers that were interviewed made a heavy metal balance for the crops. Neither had they done an analysis on heavy metals in the soil, except grower number 4 when Findus made tests for if they could use the land for crops to their baby food.

However, since the amount of heavy metals in the soil is related to the original material of the soil it is difficult to say that the soils doesn't contain a lot of heavy metals even if there wasn't a high content of heavy metals in the fertilizers that are applied to the soils. I think that a good measure to prevent high contents of heavy metals in the vegetables we eat would be to make a soil survey on the heavy metal content in the cultivated soils. However in the interview with KRAV-controller number 2 it was said that when new land is put under qualifying period for certification under KRAV there's made a soil survey. In these investigations some cultivated soils have been disapproved for containing to high amounts of heavy metals. That means that the soils must have been analyzed for their content of heavy metals. This is contradictory to what the growers answered in the interviews, where three of the growers answered that they never had done an analysis on heavy metals in their cultivated soils.

The regulations that KRAV has on heavy metals are quite strict on the sources that could be part of contributing heavy metals to the cultivated soils. This is good since heavy metals can have a really bad effect on our health if consumed in excess. Many of these symptoms are really frightening since it can affect our neurological systems. Vegetables are one of the food sources for heavy metals. For the average consumer one third of our cadmium intake is through vegetables and root crops. And for many of the other heavy metals non-occupational exposure is mainly through vegetables and meat. The problem could however be that these regulations don't seem to be implemented by the growers at least not consciously and that the controller doesn't prioritise heavy metals when controlling what have been applied to the cultivated soil by the grower.

In this study only four interviews were made with four different growers all located in the county of Skåne. The two controllers that were interviewed were also located in Skåne. These interviews are few and the participants are located in only one area of Sweden. This makes it problematic to assert the information from the interviews on all growers connected to KRAV and the information might not be generally approvable.

9 Conclusion

The aim with this bachelor thesis was to see how KRAV relates to the possible accumulation of heavy metals in organically cultivated soils in a health aspect, if they have any regulations or praxis to keep heavy metals that enter the cultivated soils at a minimum level, and what the KRAV-certified growers are doing to prevent the accumulation of heavy metals.

KRAV have good and quite strict regulations on heavy metals. The only aspects that can be criticized are:

- that the growers who are the ones that should implement these regulations doesn't seem to be especially aware of heavy metals and what cultural practices they should use to prevent them from accumulate in the soil and taken up by the plants.
- that the controllers at KRAV have a low prioritising of controlling the amount of heavy metals that are applied to the cultivated soils by fertilization and if KRAV´s regulations on heavy metals are followed by the certified growers.

Study of EU's regulations on organic production showed that the summarized version of EU´s regulation wasn't very strict. Heavy metals are only mentioned in highest allowed contained limits in some products that can be used as fertilizers and not in combination with any cultural practices to avoid heavy metals to accumulating in the cultivated soils.

It is important that growers, regulation-controllers and regulation writers are aware of heavy metals and the problems that can materialize if the soils are accumulated with heavy metals since many of the heavy metals have severe effects on our health if consumed in excess.

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11 Appendix 1

11.1Frågor ställda till 4 stycken KRAV-odlare

Gårdsbeskrivning

1. När lades gården om till ekologisk odling?

2. Vad har ni för produktion på gården?
   -grödor
   -djur
   -växthus

3. Hur stor odlad areal har ni?
   -arrende

4. På hur många hektar odlas det köksväxter inklusive potatis?

5. Vad är det för jordart på åkrarna?
   -skiljer den sig

6. Vad har ni för växtföljd?

7. Har ni olika växtföljder för jordarterna?
   -lerjord (tung)
   -sandjord (lätt)

Växtnäring

1. Vad använder ni för gödsel?
   -från gården
   -inköpta
   -vilken typ av produkt

2. Hur stor giva ger ni av respektive produkt?

3. Skiljer gödslingen mellan jordarterna/växtföljderna eller den arrenderade marken?

4. Gör ni en gödslingsplan för varje gröda?

5. Gör ni en växtnäringsbalans?
   -själv, för hand, eller med hjälp av ett data program (STANK)
   -med hjälp av rådgivare

6. Gör ni en tungmetallsbalans för t ex cadmium?

Analyser

1. Gör ni någon analys av pH i marken?
   -i så fall vad har ni för pH
   -matjord
   -alv

   Mull halt?

2. Gör ni några jordanalyser/markkartering?
   -vilka
   -hur ofta
   -när gjorde ni någon senast

3. Har ni gjort någon analys av tungmetaller i marken (totalanalys)?
   -matjord
   -alv

4. Hur går ni till väga för att hålla nere värdena på tungmetaller så att den inte överskrider gränserna som KRAV satt upp. (bilaga 3, Regler för KRAV-godkänd produktion 2004)

11.2Frågor ställda till Krav- kontrollant 1

1. Hur kontrollerar ni att KRAV: s regler runt ”växtnärings- och tungmetallbalanser” följs?

2. Enligt KRAV: s regel §4.2.5 så får det inte tillföras mer tungmetaller under en 5: års period än de mängder som finns i bilaga 3 i KRAV: s regler 2004.
   Hur kontrollerar ni att mängderna på tillförda tungmetaller inte överstiger dessa gränser?

3. Enligt KRAV: s regel §4.2.2 så har KRAV makten att underkänna en odlingsplats om den har för höga halter av tungmetaller.
   Hur går ni till väga för att ta reda på om en odlingsplats har för höga halter av tungmetaller?

4. Enligt KRAV: s regel §2.9.5 kan höga halter av tungmetaller i produkten vara skäl för sanktion, underkännande, uppsägning av anslutningsavtal eller avstängning.
   Hur går ni tillväga för att kontrollera om tex. grönsaker eller andra produkter har för höga värden av tungmetaller?

5. Har några odlare eller deras produkter underkänts av KRAV:s tungmetallregler?

11.3 Frågor ställda till KRAV-kontrollant 2

1. 2004 skulle KRAV gradvis implementera ett miljöledningssystem där de första stegen skulle vara att göra en växtnäringsbalans, markkartering/jordanalys och växtodlingsplan.
   - Har detta miljöledningssystem blivit implementerat idag och gör odlarna en växtnäringsplan, markkartering/jordanalys och växtodlingsplan?

2. Tar detta miljöledningssystem upp tungmetaller?

3. Känner du till några odlare eller deras produkter som har blivit underkända p.g.a. för höga tungmetall halter?

4. Hur prioriterar ni tungmetaller vid kontroll?

11.4 Frågor ställda till, KRAV centrala regelskrivare

1. Vilken bakgrund/bakomliggande orsak finns till de värden som är satta i KRAV: s regel 4.2.5, att det inte får tillföras mer tungmetaller under en 5: års period än de mängder som finns i bilaga 3 i KRAV: s regler 2004? Finns det något bakgrundsmaterial/rapport hos KRAV rörande detta?

2. I Kravs regel 4.2.2 stå det att Krav har makten att underkänna en odlingsplats om den har för höga halter av tungmetaller.
   Finns det något bakgrundsmaterial/rapport hos KRAV rörande detta?

3. Hur kontrollerar KRAV att detta regelverk efterföljs?

4. Har några odlare eller deras produkter underkänts pga KRAV:s tungmetallregler?

12 Appendix 2

12.1KRAV´s regulations on heavy metals

§2.9.5

The following can be reason for sanctions, disapproval, notice of cancellation or enclosure of contract with farmers connected to KRAV:

… -The products contain high contents of undesirable substances, e.g. chemical residues, GMO, or high values of heavy metals (see appendix 3).

§4.2.1. Cultivation and storage of products should be placed so pollutants doesn't lower the KRAV-approved products value as provisions or fodder. Cultivated sols that are situated within 25 meters from a road, where the traffic intensity is above average 3000 vehicles a day counted over the year, is not allowed to be used for crops meant for human consumption.

§4.2.2

KRAV has the power to fail a cultivated area if remainders of unwished substances are present, i.e. remainders of earlier used pesticides or to high values of heavy metals.

§4.2.5

Input of heavy metals to the cultivated soil shall be limited. The highest permitted average input during a five-year period of heavy metals with contributed fertilisers, soil improvement material, pesticides and other products which sooner or later is furnished to the soil (i.e. fodder, fodder-minerals and medicines) is show in table 4

§4.3.7

Imported fertilisers and soil-improvement material shall be analysed of its content of heavy metals, medical residues, radioactive substances, transmission of infection or other undesired substances, when there is reason to assume that the values can be high. This is always current for leftover products from industry and metabolic waste, i.e. aches, slag and industrial lime.