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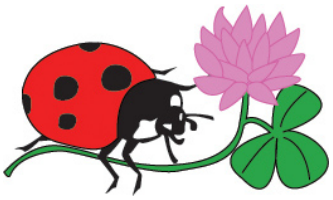

Pest management in Swedish asparagus cultivation

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Asparagus is a very nice vegetable and is becoming increasingly popular in Sweden. To succeed as a grower you have to be aware of pests that can attack this crop and how you can fight them.

Asparagus is grown in a very small scale in Sweden but the interest for this crop is increasing. The cultivations are primarily established in the south of Sweden and it is mostly the green asparagus that is grown. The first shoots can be harvested 3 year after sowing the field will productive for approximately 10 to 15 years. The harvesting season is quit short, from the beginning of May until midsummer. This article will address some of the pest management issues that can be connected to asparagus production.

Weeds

The weed control is a tricky business. Probably the largest reason that asparagus cultivations are closed down is that weeds has taken over. To avoid this, several different methods needs to be used. The most important thing is to start on a field that is free from perennial weeds since asparagus is such a long culture. Only very few chemical herbicides are allowed in Sweden. Sencor was approved in 2000 and you can also use Expand plus against quackgrass and Basta or Reglone before the emergence of the asparagus. Even if you use chemical control a large part of the weed control has to be done mechanically. It is appropriate to use some kind of row hoeing during the harvesting season. Some hand weeding is often also required. After the harvest when the plants should collect energy for the next year there is possibility for chemical control or use of row hoeing again.

Insects

In a recent article in Viola a warning is declared for the asparagus fly (*Platyparea poeciloptera*) which has been found on a location in southwest Skania. In mid Europe it has been the worst enemy of asparagus cultivation for a long time but is has not been seen in Sweden for 60 years. The symptoms are wilted shoots among the young plants which have not yet been harvested. The most effective control is to remove infected shoots.

The Asparagus beetle (*Criocerris aspargai L*) can cause great damage during some seasons. Both the beetle and the larva eat the tip of asparagus shoots. The asparagus beetle is only present in Skania and the population is mostly at a low level.

Fungi

Asparagus rust (*Puccinia aspargai*) is specific for asparagus and do not change host. The symptoms can be seen in June as yellow-orange spots which develops into small cavities. To prevent infection several cultural practices can be used. The plant distance should be large, no shoots should be left during the harvest period and when infection is heavy the plants should be removed at the end of the season and burned. Chemical control is not allowed in Sweden but is used in many other European countries.

Fusarium rot-rots include several different fungi that can attack the asparagus shoots below as well as above the ground. One of the most common is *Fusarium oxysporum* which gives smaller shoots in some parts of the field. If you look closer at the infected plants you find long, brownish and wet spots on the lower part of the shoots. *Fusarium culmurum* can be found on light soils were some shoots have become yellow. The lower parts of the shoots have brownish spots with a pinkish coating. In an American experiment potassium chloride has been used to treat these fusarium infections with good results. The mechanism behind this is not known.

Cultural practices

Pest problems can be avoided by several cultural practices. One important factor is crop rotation. For example in the Netherlands, they have seen a strong decline in plant growth when fields were replanted with asparagus. Asparagus is also very sensitive to soil compaction. These damages can be avoided by minimizing the use of tractors and using good tire equipment. It is also a good idea to bank up the soil around the shoots. It prevents the plant from falling over, which can prevent the nutrient uptake and make the plant more susceptible to diseases.

Lisa Rydenheim

Replacement of copper in organic farming

Apple scab (*Venturia inaequalis*) causes serious losses in quality and yield. To control apple scab in organic farming fungicides based on copper are used, especially in spring time. But copper causes damages in the environment and the use of copper pesticides in the EU either are permitted or will be phased out. The urgent need of a replacement of copper products in organic farming has led to the EU-financed project REPCO. The aim is to find a plant protection strategy for farmers to control apple scab.

The problem of copper

Copper as a heavy metal get fixed in the soil and causes damages to the environment. For example, Plants get chlorotic leaf, earthworms get damaged and the nurient cycle is hindered. The water is poluted by copper and fish are poisened as well as animals serving as fodder for fish. Because of that Denmark and the Netherlands already forbit the use of copper pesticides. In other EU countries the amounts of copper will be reduced stepwise. For example, the permitted amount of copper till 2006 is limited of a total of 38 kg per ha.

The REPCO project

REPCO is the contraction of Replacement of Copper Fungicides in Organic Production of Grapevine and Apple in Europe and is restricted from 1st November 2003 to 31th October 2007. Apart of apple scab the project matter is finding out alternatives to control downy mildew (*Plasmopara viticola*) on grapevine without copper. The similarity between grapevine and apple production is that both are major European organic crops with a production strongly relying on copper. Twelve different institutes and organisations all over Europe are involved in that program, for example The Royal Veterinary and Agricultural University (KVL) in Denmark, the Research Institute of Organic Agriculture (FiBL) in Switzerland or the Applied Plant Research (PPO) in the Netherlands. The main aim is finding a plant protection strategy involving old and new methods to get independent to copper in organic farming. Researches of new fungicides and antagonists which are useful in organic farming are attempt as well as finding different ways of crop cultivation reducing the appearence of apple scab and downy mildew in field. To put the researches into praxis, there is a strong link between researchers and end-users. In the end the commercialisation of project findings will be strongly emphasised and the end-users should get a whole plant protection program.

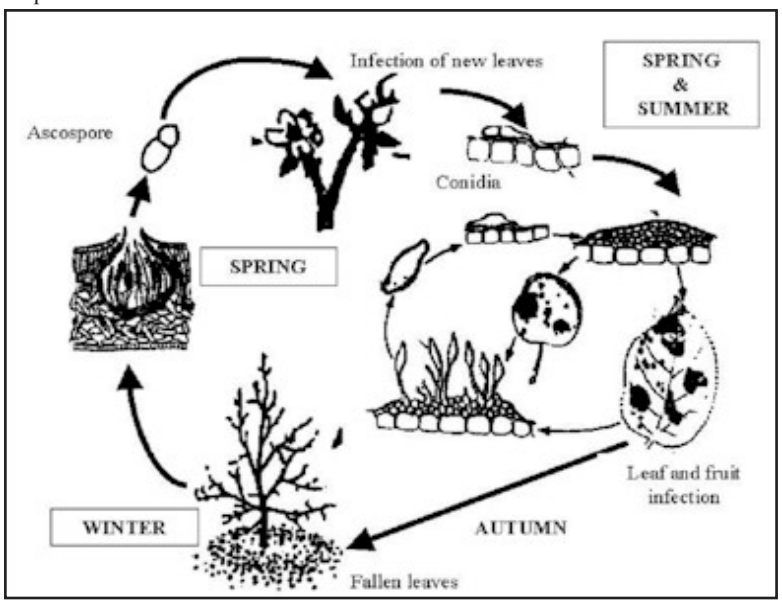

Figure 1: live cycle of apple scab

Current state of affairs

One part of the project was finding new compounds of substances which are permitted in organic farming and useful against apple scab. Over 100 substances were found after literature searches, searches on the world wide web and personal contacts. Also results from a previous program, called the StopScab project, and information from companies were taken. Different tests were carried out and apart from other promising materials one compound called E73 seemed to be a good fungicide against apple scab. According to the RimPro warning system determining apple scab infection periods, E73 mixed with sulphur was applied on apple trees cv. `Jonagold´. Compared to copper it had a better effect on fruit and extension shoots but not on the cluster leafs. A patent application is in investigation for E73. Also the substances potassium bicarbonate and potassium phophonate together with seperate sulphur applications showed good effects of controling apple scab.

The project also involves the resarch of antagonists defeating apple scab. For that, samples of apple leaves infected with scab were collected in the Netherlands, Belgium and Germany. The scientists isolated fungi which appears naturally on scab colonies and tested them of their health risk, cold and drought tolerance and economic feasibility. Tvelve isolated antagonists significantly reduced sporulation and are now tested of their mass production. Four of them were just tested in orchards in summer 2006.

Another way of reducing scab is the degradation of the old leaves (Fig.: 1). On the leaves the spores of scab can hibernate during the winter. The fewer the amount of dead leaves the fewer is the infection of scab in spring. The best way to increase the degradation was the application of Urea. Urea has also the ability to reduce the spores of scab. Unfortunately Urea is not permitted in organic farming because it is a synthetic produced substance. Only beet pulp as a alternitve showed in one year a reduced amount of spores but also a reduction of degradation. The fact that an amount of extra earthworms increased the degradation might be interesting in further cultivation methods by establishing earthworms in field. For example, a humic and moist upper soil before leaf fall increases the amount of earthworms. Clean rows at leaf fall increases the attractivity of apple leaves for earthworms because there is no competition of organic matter. Cutting the leaves seems to be a possibility to attract microorganisms because of the leafs´ increased surface after cutting.

Altogether the project shows old and new ways of defeating apple scab. Further resarches will be done to get a scab protection program useful in practice without relying on copper.

Christian Dold

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www.rep-co.nl

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Blueberry – A crop with expanding market

Blueberry (*Vaccinium sp.*) production is increasing, especially in the U.S. but also here in Sweden. The market is expanding and even though blueberry production takes time and is costly to establish, it can in the long run become very prosperous.
It is considered to be a rather healthy crop but problems may still occur. Here is a general guide to plant protection in blueberry production.

Background

Blueberries have become a popular crop worldwide. Because of the strong market for fresh and processed food, the returns for growers are good and the planted area is increasing. The new cultivars, which are better adapted to "non-traditional" growing areas, have also helped to expand the production worldwide. The main types of blueberry grown in commercial production are: Northern highbush blueberry (*Vaccinium corymbosum L.*) (Fig. 1), Southern highbush blueberry hybrids (*V. corymbosum, V. darrowi*) and Rabbiteye blueberry cultivars derived from V. ashei Reade. Northern highbush cultivars have a much greater winter cold hardiness and are therefore the type most suitable for Swedish climate.

In many parts of the world there are different wild species of blueberries. The European and Swedish wild species is V. myrtillus L., referred to as Bilberry in English scientific literature. In the U.S. and Canada, it is commonly put in the lowbush category but the commercial lowbush fields today mainly consist of native clones of *V.angustifolium* with some clones of *V.myrtilloides* mixed in, depending on the region. The lowbush blueberry is mostly commercially grown in Canada and the U.S. and often marketed as "wild blueberries".

One of the reasons for blueberries becoming increasingly popular is that a new market has arisen. The pharmaceutical industry has shown great interest in the high levels of antioxidants present in blueberries. They have since long ago been proven to be efficient in eye medication.

The most common types of North American blueberries are not winter cold hardy in the north of Sweden and therefore commercial production is not possible there. However, there is a research project partly initiated by SLU in Umeå, going on at this time in the north of Sweden. The purpose is to attain an efficient method of establishing *V. myrtillus* in commercial production, so-called "domestication", which has been performed earlier with cloudberries in Finland.

Fig. 1 Vaccinium corymbosum

Growing blueberries is costly to establish due to expensive plant material, and the time it takes for blueberry plants to give full yield (8 years). In the first 4 years there are only expenses. But given the expansive state of the market for blueberries today, the investments give good returns. For example, one grower in Sweden gets net proceeds of about 150 000 sek per hectare at full yield.

Pests and diseases

Blueberry is generally considered to be healthy and vigorous crop and it is possible to avoid many pests and diseases by proper managing and growing conditions. Of the diseases and pests reported on blueberries only 20 to 25 ever become abundant enough to cause economical losses, and only 5 or 6 of these are chronic problems that require control every year. The most damaging pests are those which attack the buds, destroy the fruit, or threaten the survival of the plant.

Fig. 2 Botryosphaeria dothidea

Cultural problems which may occur in production of highbush and lowbush blueberries in North America are: spring frost injury, winter cold damage, drainage or undesirable pH, pollination issues, excessive rain at harvest and difficulty managing irrigation.

In the U.S. production problems varies between different regions. Insect pests are of course more common in the warmer parts. Disease problems are prevalent in all production areas.

Some of the most common diseases are blueberry scorch or shock viruses, mummy berry (*Monilia vaccinii-corymbosi*), alternaria (*Alternaria tenuissima*) fruit rots and botryoshaeria stem blight (*Botryosphaeria dothidea*). The pests are few in the northern parts other than aphids as a vector of blueberry scorch virus. In lowbush blueberries, blueberry maggot (*Rhagoletis mendax*) is the most serious pest. Other problems can be weeds, birds, deer and rodent pests.

Management

The most important preventive measures is to use healthy cultivars and maintain the right soil conditions which means low pH (4,2-5,5) and high levels of organic matter. Other important measures are: Preserving of natural enemies, monitoring growing fields, removing and burning infected material, carefully planned strategy for applying pesticides, growing cover, crops to prevent weeds, removing flower blossoms the first two years to help establishment, and annual dormant pruning. Single infected plants spotted in new production field should be removed and burned. Pollinating insects should be protected because they are important in increasing the yields. The diseases are treated based on knowledge of their biology.

The blueberry scorch virus is spread by aphids and the plants do not recover. Except for planting virus-free material, you should remove the infected plant and control aphids.

Monilia overwinters in the soil where infected fruit have fallen the previous year, and infects the new leaves in spring. The inoculum can be reduced by collecting and destroying the infested fruit by cultivating the soil around the plants to bury the mummies.

Stem blight (*Botryosphaeria dothidea*) (Fig. 2) is a vascular disease which often starts from a wound infection site. Removal of infected wood and pruning below the infected area

is the only practical control for Botryosphaeria stem blight. Since infection can spread throughout the growing season, growers should prune during dormancy.

The fruit rot fungi (*Alternaria tenuissima*) can cause severe losses both before and after harvest. Timely harvesting, sanitation and post-harvest cooling are essential for maintaining fruit quality.
Adult flies of blueberry maggot are important to look for just before harvest. They can be collected on sticky traps and the number of adults serves to give lead time for chemical control.
To protect the crop from birds you can use nets, chemical repellents, scare tactics and noise devises. Fencing is the most important measure for reducing deer damage.

Mira Rur

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Hawaii: Taming the spread of the banana bunchy top virus

Bananas are the fourth largest produced fruit crop worldwide, but one virus is threatening all varieties in almost every banana producing region. The Banana Bunchy Top Virus, considered to be one of the most damaging diseases to the banana plant, is spread by the banana aphid. This virus is a concern to banana growers because improper management of the virus can lead to poor economic returns or to a total loss of their banana production.

Since 1989, Banana Bunchy Top Virus (commonly known as BBTV) has been aggressively spreading around the state of Hawaii. Control of this virus, therefore, must be just as aggressive. Once established, the BBT virus is difficult to eradicate because the banana aphid (Pentalonia nigronervosa) acts as a vector in the spread of the disease. Although damage caused directly by the banana aphid is negligible, it is the only non-human source for the spread of BBTV; therefore, active management plans are needed to minimize aphid colonies to help slow the spread of the disease. The other source for the spread of BBTV is through humans improperly moving and handling BBTV infected plant materials. It was through this second method that BBTV spread internationally and established itself as a problem for most banana producers.

Monitoring

In order to catch BBTV in its early stages, active monitoring and scouting for aphid colonies by the grower should be conducted. Since infected plants may harbour the virus without symptoms for up to 125 days, early detection of the virus is often difficult. Banana bunchy top virus is typically found on younger "keikis" which are suckers from the mother plant.

Fig. 1: banana aphid

New leaves are generally bunched and deformed with yellow and wavy margins. Leaves may also display a streaking or "morse code" pattern. Plants with BBTV are usually stunted and will not produce bananas or will only produce small and deformed fruits.

Prevention and Control

Fig. 2: leaves normal leaves bunched up

Even with ongoing research, experts at the University of Hawaii's banana extension do not believe a cure for BBTV is likely; therefore, they promote prevention as the key to BBTV management. Prevention of aphids potentially carrying the banana bunchy top virus is often controlled though the use of chemical sprays in commercial banana production; however, promising results from experimental trials using biological control methods have been published in recent years. The first alternative to chemical control is the use of the entomopathogenic fungus Acremonium sp. to help reduced the aphid population size through reduced reproduction and slowed development. The second alternative is to use the HI-24 isolate of the entomopathogenic nematode Heterorhabditis sp. to increase aphid mortality.

Other preventative control measures for banana aphids include monitoring of other host plants such as red ginger and taro plants and eliminating ant populations that can provide protection to banana aphids from natural enemies. Backyard banana growers may also help prevent the spread of BBTV by planting only certified BBTV-free banana plants and by properly killing aphids and destroying banana trees if BBTV is found. Infection by the virus can be confirmed through visual inspection or through the use of an enzyme-linked immunosorbent assay of plant sap.

Current Research

Hawaii is still actively working to isolate and to prevent the future spread of BBTV to other parts of the state. A cooperative research project that began in 2004 is currently being conducted at the Tropical Plant Physiology, Disease and Production Unit in Oahu. The main objectives of this project are to better understand the banana aphid's distribution within plantations; to determine the effects of imadocloprid (Provado ®) on banana aphids; to create an island-wide management plan for BBTV; and to establish a coordinated program for educating the population of BBTV and for dispersing new information. This research project is scheduled to conclude in 2009.

Kimberley Wong,
University of British Columbia, Canada

Microwave-based weed killer machine

Weed control
The interest of non-chemical weed control systems are raising, and with the productivity within the subject. One way of controlling is with the use of heat. Flaming or steamer is the most common ways to day. Both of these methods has there drawbacks, there fore is it important to find new ways and one of them is the use of **microwave-based weed killer machine**. This machine have not jet reached the market sins it still are under analysis and testing. The idée is the same as with the other thermal systems, to affect the water content within the weed, forcing it to wither.

History
The idée to use electromagnetic fields came up in 1971 new similar ides were on the table 1973 and 1975. The idée of using microwaves were reconsidered in 1991, 1998 and 2003 by different researchers.
Soil irrigation with microwaves was considered fore the use to kill weeds, pests (Nematodes insects) and fungi. The idée was abandoned due to the high energy needed to penetrate deep in to the soil. The soil water had a strong absorption on the microwaves and therefore was the sufficient energy amount needed to high to be economical.
Later on the focus landed on the pre- and post-emergence weed control.

Dielectric
The micro waves have the ability to penetrate biological tissue, and it interact were well with water. When the microwave penetrates the plant it forces the polar molecules to turn, there will be a fiction between the molecules which leads to a lot of heating within the plant. The heating will get grater if there is a salt concentration within the tissue, which it is.
During that possess a high loss of energy will take place within the plant.

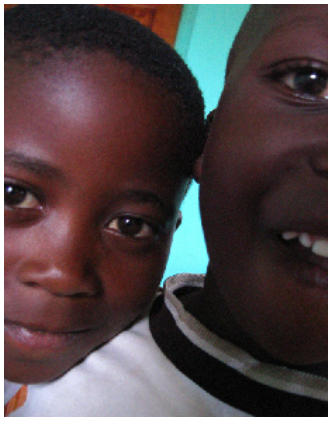
As with the other thermal methods there is no soil disturbance and there is no side effect that stimulates new weed growth. Studies have showed that the rate of energy needed depends on what caned of a weed you are after to kill, fore example did a mustard (*Brassica* spp) take 4 times as much then a soybean (*Glycine max* (L)Merr.). The tolerance also depends on the shapes of the weed experiments with a mobile microwave shows that broad leaved species had a lower tolerance against the micro waves then small leaved such as grasses.
Further more, the amount of energy, the position of the weeds in relation to the micro-machine, plant morphology (shoots ore leaves) and the plant species are more factors that have to be considered in addition to get the truth out of the microwave-based weed killer machine.
Experiments show that it is possible to control young plants with microwave-based weed killer machine. The experiment indicates that there is no relationship between the plants that are killed and the biomass of the plant.
In terms of energy when it is compared to flaming the microwave-based weed killer machine is 10 times as high, which is if we have an energy source of diesel fuel.
It should be remembered that the idée of using microwaves are younger then the use of e.g. flaming, so it will be needed with further research to fined a way to reduce the energy rate and get the microwave-based weed killer machine competitive.

O. Benderius

Africa: A continent dying from pesticides?

More than 120 000 tonnes of toxic waste originating from pesticides is stored all over the African continent according to FAO. The obsolete pesticides are often stored in inadequate facilities which often lead to pollution of the groundwater and soils as well as being a hazard to the human population. Weak legislation and poor knowledge about pesticides and pesticide application and inferior knapsack sprayers are major factors causing poisoning of many farmers and workers. Tens of thousands casualties per year are caused by the use of pesticides and millions are intoxicated. WHO also reports that the number of suicides committed using pesticides in many central African countries are increasing. Sven Axel Svensson, senior scientific officer at the department of landscape management and horticultural technology gives his opinion about the pesticide situation in Africa:

My personal opinion is that some of the putative suicides really are suicides, due to that its an easily accessible possibility that people have in developing countries as an alternative to medicine which is a common alternative in developed countries. However, many of the putative suicides could just be accidents. Accidental poisoning by pesticides can happen due to several reasons, leakage to ground water due to improper storage leading to polluted drinking water. Spray operators and other workers in the crop field working without protective measurements, children and uninformed people could get in contact with pesticides without knowing the poisoning effect.
The destruction of old pesticides is expensive, involving extremely high temperature combustion, so one can't exclude that someone's making money out of dumping obsolete pesticides in African developing countries. Without having a specific example about an organisation or a country dumping pesticide in Africa, there is so much evidence pointing in that direction



that is has to occur. Aid agencies from different countries could be involved in the dumping of pesticides without knowing it, since they don't have the specific knowledge about pesticides. The lack of knowledge might result in shipping obsolete pesticides as a misdirected aid. There are several examples where developed countries have shipped pesticides in containers without any information of information in for example Japanese to be used in African countries. Several pesticide containers have also been made in materials that rapidly corrode in the African climate.
We must support education and information in the developing countries. This can be achieved by the export of agricultural products where the products have to fulfil special requirements that include the use of pesticides. This will increase the pressure on education and information in the production countries, reassuring that the education improves by the aid of developed countries. The quality requirements can also be seen as an obstacle in trade but should be used viewed in a long term perspective as an aid to improve pesticide practices. The experiences learned from the export of agricultural products, with their required legislation concerning the use of pesticides could over time be implemented on the domestic food production as well. The education must be supported by national regulations which is absent in many developing countries. The regulations is a very important tool to achieve good pesticide practices, in combination with education and information, this since regulations could be the argument for education and advisors helping the farmers. This alternative must be regarded to be a better alternative in the longer perspective rather than just shipping obsolete pesticides.

Simon Jeppson

Environmental responsibility of growers

The changes and rationalisations that have taken place in agriculture and horticulture in the past have resulted in reduced biodiversity. One of the reasons for the impoverishment of the flora and fauna has been – and to some extent still is – the use of pesticides.

The Swedish government is convinced of the importance of reducing pesticide risks for the population and the environment, and therefore adopted a far-sighted policy in 1986. At that time all key actors were brought together to work for substantial reductions of pesticide use and to adopt less dangerous pest management strategies.
Additionally, by signing the 1992 Convention on Biological Diversity, Sweden has committed itself to protect the value of the agricultural landscape for biological and food production, while at the same time biological diversity and cultural heritage are preserved and strengthened. This goal is one of fifteen similar others, each aimed at giving the next generation in Sweden a society in which all large environmental problems are solved.

Grower's task
Ensuring the sustainability of horticultural production is a concern of growers anyway, since the income depends directly of the land under cultivation. An intact and healthy environment together with a matching production management will lead to the highest yield possible and pest management is a very important part of it. Everyone who uses pesticides has a responsibility to ensure that they use them correctly and effectively.
A useful guideline is included in the so called "Good Practice of Plant Protection" which is common in many European countries. Related to that the list in the box to the right is not exhaustive; however it gives hints of what to think about when contemplate plant protection.

How application of pesticides should not be done.

Seek assistance?
For further help, assistance and modifications the grower can find different national responsibilities. The most important are the Board of Agriculture, the Swedish Environmental Protection Agency and the Plant Protection Centres.
The Board of Agriculture tries to ensure that horticulture is conducted in a sustainable way adapted to environmental concerns, in order to obtain the national environmental quality objectives.
The Swedish Environmental Protection Agency is a central environmental authority under the Swedish Government. Its tasks are to coordinate and drive forward environmental work nationally and internationally. The overriding aim is to solve all the major environmental problems within one generation. One of its arrangements was therefore the implementation of the Integrated Product Policy (IPP) which enables every actor in the production chain to do something for sustainable production.
The Plant Protection Centres are eventually of the most importance for growers. Alongside developing prognoses and early warning methods for pests and diseases and diagnoses the Plant Protection Centres take active part in a large number of courses, field excursions and conferences. In five different locations in Sweden they also provide advisory and study material and most of the information is published on the Internet.
Adapting the use of pesticides according to the actual need is very useful for both: society's environmental concerns and for every grower's financial situation. That is the point why growers should be concerned of the environmental consequences their plant protection management has.

Juliane Barten

- The person applying pesticides must be trained and possess the sprayers licence
- Think of other possibilities besides chemicals to prevent or fight the pest
- Use as few chemicals as possible and only if it is really necessary
- Be aware of the action and economical threshold
- Use only approved products
- Follow the label instructions
- Keep locked storage of pesticide stocks
- Use safe spray equipment
- Wear safety gear
- Adopt safe filling-up and emptying procedures for sprayers
- Prevent spray drift
- Mind the no-spray buffer zones
- Dispose pesticide waste properly
- Keep records

For further information:

Swedish Board of Agriculture (here you can find the Plant Protection Centres too)
www.sjv.se

Swedish Environmental Protection Agency
www.internat.environ.se/index.php3

Pine weevils – What you can do against them

Ever since there has been forestry present the problem with pine weevils have existed. Forestry's lose large amount of money because of pine weevils eating the bark of trees, mostly within the *Pinaceae* family and this will lead to decreased transportation of nutrition due to damage of phloem. An adult tree can handle the injuries much better than a newly planted one, this will lead to difficulties when replanting after a clear-cut.
The foresters have to spend much money on strong chemicals to prevent the plantings but also their missing income is a large problem.

Biology
Pine weevils are a black to black brown insect with yellow spots. They can be 8-14 mm long. The pine weevils are present in whole Sweden, but the most of the damage is being done in the south and middle part of Sweden. The damage that the insect does is to eat from the outer bark. Small saplings can not handle the damage and will die. A large, adult tree can handle small to major attacks.
The development time from egg to adult is one and a half to two years in the south of Sweden and two to three years in the north part of Sweden. The swarming period is in the spring when the temperature is over +18°C.

What to do?
There is some biological prevention methods like tillage of the soil before planting, plant size and health and let the clear-cut rest for two to three years with missing income but those preventions are not so efficient.
Insecticides have been use since around 1950 to prevent the saplings from damages. When the pine weevil has eating or touch the insecticide it will be sick or lose its apatite so it will starve to death. The insecticides that are being used today are very strong and harmful to both environment and water. In the moment there are only two insecticides used in Sweden; Cyper Plus and Merut Forest WG. Two more insecticides waiting for permitting is; Karate Zeon and Sumi-alpha 5 FW.

Charlotte Olsson

Induced plant defence

When you see a tree which leaves are attacked by numerous herbivores you may probably believe in no future for it. But then after a while the tree is looking healthy again and you wonder why since you neither controlled it biologically or conventionally. This "phenomenon" may be explained by an induced defence of the tree. Plants are smarter than we think and with a little respect in mind for what nature has developed through evolution, we could learn from it and apply these defences in our crop productions. With this article I will try to give You a basic understanding of the term Induced defence, as well as the prospects for its future use in the horticulture business.

According to Richard Karban and Joseph Kuć, researchers at the university of California resp. Kentucky, the term induced defence can be explained by pathways that are stimulated by either a pathogen or an herbivore so that a response initiates against the pest. Another researcher, P G Ayres that wrote "Pests and Pathogens plant responses to foliar attack", stated the importance of the condition of the plant for how large its response would be. If the plant is rich in nutrients, in carbohydrates and not suffered from stress it would be more able to allocate these and therefore get a better defence. The availability of secondary metabolites is also important and when the defence is induced the amount of the pre-existing secondary metabolites is altered.

What is an induced plant defence?
The defence is called "induced" since the responses are expressed only after infection. This means that if the induced compound is a secondary metabolite it does not need to be present from the start. The compounds can be either locally or systemically induced. This inconsistent resistance can be an advantage for the plant compared to consistent plant traits such as thorns since pests more easily adapt to them. As the induced defences exist only when needed they are also requiring less energy for the total development of the plant if the plant is not attacked to often.

Salicylic acid against fungi
There are many pathways that may be stimulated by the pests and one of the most currently known is the Salicylic acid pathway. Salicylic acid produces the protein chitinase that degrades the chitin structure of fungi and it is also known to produce oxidative important enzymes such as peroxidase.

Application methods
There are two methods developed from the plants´ induced defence that can be used by humans for plant protection. One way is to inoculate the plants with strains of a pathogen and hence vaccinate them, explains Karban and Kuć. But vaccination is not a widely used technique in Plant protection even though it increases with increasing knowledge. Commercially it is used today against few mite pests. An important thing with vaccination is to use the right amounts when applying the pathogens to avoid the risk of instead developing harmful populations of the pest. The alternative method to vaccination with none such risks is then to use chemicals and one example of this in commercial production is BTH; a synthetic inducer of salicylic acid. BTH is currently used in Europe to control Powdery mildew. So far the application of chemicals has been shown more efficient against pathogens than against herbivores.

Future prospects
The development of the production and the application in the fields will depend on money and trust, both from the growers and from the chemical companies. If we are able to control serious pathogens like viruses that today are incurable, we will have a market that should be of large interest both for growers and for the pest management companies.

Anna Eriksson

Recirculation is the future

Changes in legislation will demand that greenhouse producers use closed irrigation systems or an efficient purification of surplus water. The Bio-Zip water purifier is one alternative to meet these requirements. The greenhouse producer Bengt Jönsson is very satisfied with his investment in the Bio-Zip.

Bengt Jönsson, an optimistic greenhouse producer in Löddeköpinge, mainly produces herbs but also poinsettia and tuberous begonia. Earlier, only a simple textile filter cleaned his closed irrigation system. At that time he faced a lot of problems with different fungus diseases, for example caused by Pythium and Phytophthora. Since one and a half year his problems has almost disappeared, and he does not need to apply as much fungicides. This is due to his investment in the Bio-Zip water purifier, from Agua Trading in Löddeköpinge. Bengt Jönsson was one of the first to utilise this water purification system and he is very satisfied with the results.

Advantages with recirculation

Changes in legislation will demand either closed irrigation systems or efficient purification of surplus water, for greenhouse producers. Recirculation of nutrient enriched water will of course lead to a cost reduction of water and fertilisers, approximately 30 per cent reduction of the total cost. The environment also benefits from such systems, by its way of keeping the nutrient enriched water from infiltrating the groundwater.

The Bio-Zip process

In the Bio-Zip system incoming contaminated water is forced through a particle remover, where most of the particles are separated from the water, before it flows into a biological purifying unit. In this unit it passes through the filter media, Aqualite, the carrier of the process bacteria. Aqualite is a mineral with a large active area (one gram of Aqualite has an active area of 400 square metres), adsorption and ion-exchanging properties. Both aerobic and anaerobic environment can be achieved in the biological purifying unit. After the biological process the water flows into a post sedimentation tank, where dead bacteria and other particles settle. The residues are pumped back to the particle remover, while the processed water is ready for recirculation. During normal operation in greenhouses, the filter media does not need replacement. An efficient particle remover in combination with a back flushing technique of the Bio-Zip system will prolong the life time of the filter.

The Bio-Zip water purifier system.

The great number of the non-malignant bacteria, in the Bio-Zip filter, will fight the bacteria and other microoganisms which generate diseases. The filter also reduces nitrogen by nitrification and denitrification. The amount of phosphates are reduced and the organic substances are consumed, during the bacteriological processes in the filter. Elimination of non-natural substances and heavy metals, due to its strong ion-exchanging properties, is also taking place.

Other purification techniques are for example pasteurisation, UV-light and traditional slow retention time filters with mineral wool or sand as carrier of the process bacteria.

Paul Lindh, the inventor of the Bio-Zip and also the owner of the company Agua Trading, tragically died of a heart attack in March 2006. His wife Lena Lindh is now under the process of selling the patent. Only the future will tell what will happen with the Bio-Zip.

Jessica Fajerson

The filter media, Aqualite.

The return of the Carrot Psyllid

During the past five years infestation density of the carrot psyllid, Trioza apicalis, has been very small at Ola Fredlunds organic farm in Valbo, Gävleborg, but this year the carrot psyllid has returned. The carrot psyllid is a pest in carrot production that can cause sever damage. Large infestations are often connected to areas with a lot of conifers that is the insect's winter host.

The last time Ola Fredlund had infestations of the carrot psyllid was the year 1994 followed with increasing infestation in year 1995 and 1996. After these years all fields were covered with fibre cloths. During three years almost all carrots were produced under fibre cloths. The summer 1998 was a very cold and rainy season and the following year 1999 carrots that were produced without cloth showed no infestations of the carrot psyllid. Ola has some thoughts that the rainy and cold summer 1998 reduced the population of the carrot psyllid. Another factor might be the long period with covered production. The following seasons 2000-2005 carrots were produced without fibre cloths and only very small infestations of the carrot psyllid were observed. This season, 2006, the population of the carrot psyllid has increased and caused large infestations foremost on small fields with early carrot varieties. Larger fields, foremost with late varieties, have only small infestations in the edges of the fields.

The increase of the carrot psyllid is, according to Åsa Röhlin an adviser in field vegetable production from Hushållningsällskapet in Värmland, a local population increase rather then a general increase in Sweden. Ola is not the only producer to have problems with the carrot psyllid. Many carrot producers in the middle of Sweden and also on the west cost have had or have problems with the carrot psyllid. The carrot psyllid population seems to fluctuate between years. Areas with little infestation one year can have large infestations another year.

To control the carrot psyllid in organic production it is important to move the carrot production between different fields every year, if possible large distances. By cover the fields with a fibre cloth or an insect net directly after sowing a good protection against the carrot psyllid is gained. To cover the fields with cloth is very labour intensive and therefore not desired from the producers. According to Åsa an idea would be to test if just covering the fields every second year can keep the population low.

Carrots infested by the carrot psyllid. Typical symptoms are the curling of the leaves and the growth reduced plants. (Foto: Karin Ellgardt, Valbo, 2006)

During this summer a one day course in Dalarna were arranged by a group of producers to have discussions and excursions. The group includes 10-11 cabbage or carrot producers. Two advisers were also connected to this group, Elisabeth Ögren from Länsstyrelsen in Västerås and Åsa Röhlin from Hushållningssällskapet in Värmland. One of the main issues that were discussed during this day was the problem with the carrot psyllid in organic production. The reason why this subject was in focus this year was not due to a large invasion of the pest, but was a request from the producers that have seen an increase in infestation the last ten years.

An external lecturer Olle Andebrant from Lunds University was invited to talk about the latest research on the carrot psyllid. The impression Åsa and also Ola got were that it were still a lot of questions to be answered about the carrot psyllid. Interesting research result connected to the winter host has reviled that the carrot psyllid have been found over wintering on 5 different conifer species, compared to spruce that are mentioned in most literature. Spruce was favoured by the insect, but large amounts of carrot psyllid were also found on juniper that often is left in enclosed fields. The research result showed that carrot psyllids have been found high up in the trees and that they had the ability to spread over one kilometre from the carrot fields. This increases the questions about in which way carrot psyllid invades a field.

Ola Fredlund has some ideas how to control the pest next year without covering the whole field with cloths. The idea is to use a trap crop surrounding the field that is harrowed down after egg laying and addition to this trap crop cover the closest area inside the trap crop with a fibre cloth. According to Åsa Röhlin trap crop that is harrowed down, in combination with a crop rotation with large distances have given positive results. Ola's idea could be a potential solution but little information is known how the pest invades the fields. Often infestations are observed in the edges of the fields. The new knowledge about how high and far the insect has been observed makes it difficult to say that the uncovered crop inside of the trap crop and the covered crops is safe from the carrot psyllid.

Biology

Early in the summer over wintering insects are flying into the carrot fields were reproduction and egg laying takes place. From the egg a nymphs hatches that undergo five instars before a emerging as an adult in the end of the summer. In September the new adults migrates to its winter host, conifers. Other Apiaceae species may also act as a summer host but the carrot psyllid prefers carrots. The carrot psyllid has one generation per year and the over wintering adults die after reproduction and egg laying.

The symptoms are caused when the adults and nymphs from the third instars is feeding on the leaves. When insect is feeding it injects an unknown toxic substance that causes curling of the leaves and secondary growth reductions of the entire plant but foremost of the roots.

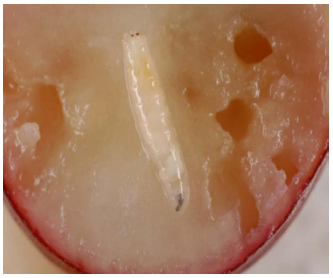
Karin Ellgardt,
Horticulture student,
SLU Alnarp

Biological control of Cabbage Root Fly

Research in biological control methods for management of the severe pest cabbage root fly is carried out throughout the temperate region of the world. New approaches include development of decision support systems, entomopathogenic fungi and nematodes, adjustment of sulphur nutrition, and intercropping.

Cabbage root fly, *Delia radicum*, is a major pest wherever *Brassicaceae* crops are grown.
The maggots attack the roots of the crop, which will soon suffer from inadequate water supply and wilt. Secondary bacterial rots are common. The quality of the produce will be heavily lowered, especially in root crops, with economical losses.

Traditional management strategies
The most common management against cabbage root fly has been chemical control by seed dressing, granulates, and sprayings against the maggots.
In small fields covering with fibre cloth or insect net to prevent the female adults from deposit the eggs is highly efficient.


Maggot of the cabbage root fly, *Delia radicum*

New approaches
Spraying against the maggots with pyrethrum solution has yielded a quite good effect in Finnish trials. Prognosis systems are used in Denmark, where egg laying are monitored and related to optimum time for managing the maggots.

Entomopathogenic fungi
Trials in UK with entomopathogenic fungi against soil-dwelling stages of the cabbage root fly shows promising results. A conidia suspension of the fungus *Metarhizium anisopliae* was drenched onto the base of egg infested plants, and this reduced the number of larvae with up to 90%. Under glasshouse conditions this treatment was comparable in efficiency to routinely used fungicides (iprodione and tebuconazole).

Entomopathogenic nematodes
Promising results from trials with infective juveniles of the nematode *Steinernema feltiae* against young maggots are reported from Belgium. In greenhouse the method was effective, but field control was only successful in summer application compared to spring. The surviving insects and the crop damage were reduced.

Level of sulphur application
Studies in Switzerland, shows that the oviposition preference of the cabbage root fly is influenced by the sulphur plant nutrition, and thereby the level of glucosinolates in the plant. Different levels of sulphur application were tested on cruciferous plants. On plants that contained normal sulphur levels females laid more than threefold as many eggs as on the plants low in sulphur. This could imply that excess sulphur fertilization should be avoided, and that cultivars with lower levels of glucosinolates could be chosen.

Companion planting
An UK investigation found out that, in diverse plantings, the flies are arrested by non-host plants rather than repelled. The flies spend a protracted time on non-host plants, and this disrupts them from finding the host plants.
Other UK researchers tested a range of non-host companion plants which were aromatic, purple-foliaged, ornamental or weeds. Fewest eggs were found to be laid on host plants surrounded by the weed *Chenopodium album*. Reddish foliage was seen to be less disruptive than green foliage of comparable cultivars. Aromatic plants were not more disruptive than other plants.

Biology of cabbage root fly
The cabbage root fly over winter as pupae within hard puparia. After emergence, the blackish adult fly deposit the eggs in groups close to the stems of host plants. The first generation maggots hatch after one weeks (mid May) and start to feed on the roots. The larvae feed for 3-4 weeks and then pupates. Adults of the second generation, which makes the most damage, appear in July.

Linda-Marie Rännbäck

Sexual reproduction of potato late blight – cause of concern for Swedish growers

For about 20 years ago the second mating type, A2, of potato late blight (*Phytophthora infestans*) was confirmed to appear in potato fields in Sweden. This gave a possibility for sexual reproduction of the pathogen resulting in an increased adaptability and aggressiveness. Outbreaks of this blight is harder to control with fungicides since the early infestations appear at the lower parts of the plant and direct on the tuber compared to those caused by airborne inoculums. These are new infection sites of the pathogen that are important to take into consideration for the grower according to plant protection.

Background

P. infestans originates from Mexico and when Columbus first brought the potato to Europe in the 1500s it was free from the pathogen. But in the middle of the 1800s a shipment of seeds of potato from America to Belgium by mistake brought one strain of blight, later called A1. During that summer the late blight spread through Europe and caused several yield losses.

In the 1970s another strain, A2, was found in an isolated part of Mexico. Before the 1980s A1 was the only strain of blight appearing outside Mexico. However, A2 was found in Sweden 1986.

Biology

The oomycete *P. infestans* is heterothallic and can only reproduce sexually if both mating types, A1 and A2, are present. Before the introduction of the second mating type in Sweden, the pathogen did only reproduce asexually by producing vegetative sporangia. The sporangia have no survival structure and the pathogen did only survive the winter as mycelia in stored seeds of potato.

The coexistence of both mating types gave the opportunity of sexual reproduction resulting in oospores. The major issue of the oospores is its ability to survive in the soil over the winter apart from potato tissue. By this independent survival the late blight is to be considered a soil born disease.

Damage

P. infestans is the most important fungal disease on solanum-species and causes serious damage in potato cultivation worldwide such as late blight (Fig. 1) and tuber blight (Fig. 2). Late blight affects all parts of the potato plant, but the tubers are of most concern for the grower with, until recently, only two possible ways of infection. The first; spores produced on leaves being washed down in soil by rain or, the second, the infection occurs in the storage. However, the soil born oospores from the sexual reproduction have shown to cause a primary infection on the tubers directly in the soil as soon the conditions are accurate. These new infection sites of the pathogen have resulted in an earlier occurrence of the pathogen in the season. It has also shown new infection sites in the lower part of the plant in contrast to the airborne sporangia in the upper part.

Fig. 1: Lesions caused by late blight on potato

Fig. 2: Rot caused by tuber blight on potato

Control

The coexistence of both mating types, A1 and A2, has given the pathogen an increased genetic diversity which shows consequences as a higher degree of its adoptability. It appears to be more aggressive and may in the future develop resistance towards fungicides. There are some resistant cultivars but they do not meet important characters such as quality and yield.

Previous infections, before the soil borne oospores, the infection appeared rather late in season and the yield could be sustained with limited applications of contact fungicides.

As a direct result of the new strain the use of systemic active fungicide has increased. This due to the infestation sites is near to the ground and the difficulty to penetrate the plants.

With oospores as inoculums, the pathogen is to be considered soil born and new plant protection strategies must advance to prevent epidemic outbreaks.

So, the ambition towards limited application of fungicides in potato cultivation may in the future be hard to accomplish.

Kristine Karlsson

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Dutch Elm Disease

The Dutch Elm Disease caused by the fungi *Ophiostoma ulmi* and *Ophiostoma novo-ulmi* belongs to the 100 most dangerous diseases in the world. The disease does not yet threaten any elm in its existence as a species, but it has killed uncounted millions of trees in three continents. For example South England notified until 1983 loss of 20 Million elms – of formerly 23 Millions. The disease takes also in North America a dramatic progress, 200 Million elms died in 45 years.

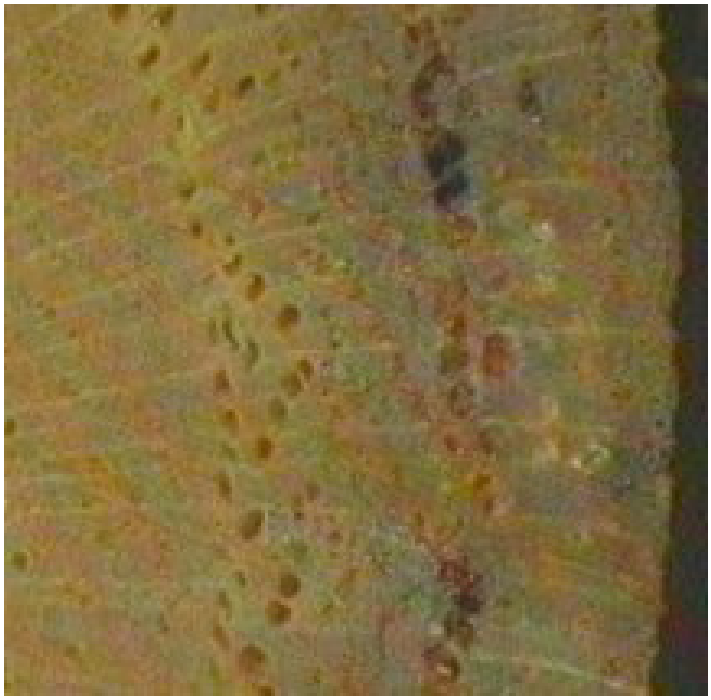
History

In 1918 a fungus, *Ophiostoma ulmi*,living in East Asiatic elms was displaced by humans to the Netherlands and spread from there all over Europe. In opposition to the East Asiatic elms, which were adapted to the fungi during the evolution, the European elms were attacked by the Dutch Elm Disease. From Europe *Ophiostoma ulmi* came to North America, where it has devastated native populations of elms which had not had the opportunity to evolve resistance to the disease. In the forties the epidemic faded away, because *Ophiostoma ulmi* had lost his virulence. In the sixties of the last century a new and more aggressive fungus, *Ophiostoma novo-ulmi*, appeared. By the wood of Canadian elms a subspecies of the fungus, *Ophiostoma novo-ulmi* ssp. Americana, was imported to England. Independent from these one another subspecies originate in Russia. Now both subspecies have a wide range in Europe.

Disease Cycle and Symptoms

The Dutch Elm Disease fungus is mainly transmitted from tree to tree by the European elm bark beetle Scolytus multistriatus and the American elm bark beetle *Hylurgopinus rufipes*. The infection with DED usually occurs from late May to July while the trees are producing "early wood" in the form of large vessel cells. During young bark beetles are eating, the fungus will be transmitted and spreads into the vessel cells.

The first visual symptoms are what are referred to as "flagging" within the crown of the tree. Flagging is a branch of a tree that develops symptoms of wilting and yellowing of the leaves on



an otherwise apparently healthy tree.Under the bark dark stripes are to see, in the diameter to see in form of dark points (see figure above). These are the changed colours of the tracheae of the "early wood". The bark beetles flies to ill or dead elms for brooding. The larvae bore into the bast and touch the tracheae with the spores of *Ophiostoma ulmi*. The adhesive spores stick on the young bark beetles and will be carried again to healthy elms.

Elms are killed after all through a lack of water. As a reaction of the infection the host closes the tracheae with thallus. This reaction is called tracheomycosis.

Management Strategies

Treatments against the spread of the Dutch Elm Disease concern to the vector at first. Until April at the latest, the dead trees have to cut down, to peel the bark (barking) and the bark beetles must be destroyed. In warm summers, when the second generation of beetles are born, the process must be repeated on the new dead trees in the beginning of June.

In cities, parks and on single trees the disease can be slackening through punctual interventions. But it is only successful if the tree crown is less than 5% attacked and the symptomatic parts must be more than three meters away from the trunk. A direct fight or a prophylactic treatment against pathogens is hardly possible, but sanitation proved as successful.

The disease can also be slackening with fungicides which are injected under pressure, but in the long run it can not be stopped. Especially, if ill elms stay preserved in the surrounding and a permanent inoculation will be there.

Long term, the problem can be solved by resistance breeding. There are a few resistant, but not immune clones of elms, in which the fungus can not spread in all parts of the vessel cells. Three major groups of resistant cultivars are commercially available. The Princeton Elm, a cultivar selected in 1922 by Princeton Nurseries, was to be highly resistant in oculation studies in the early 1990s. Another clone is the Liberty Elm, a set of five cultivars produced through selection over several generations starting in the 1970s. Marketed as a single variety, nurseries selling the "Liberty Elm" actually distribute the five cultivars at random. Two of the cultivars are covered by patents. The Valley Forge elms, and some related cultivars, have demonstrated resistance to Dutch elm disease approximately equal to that of the Princeton elm cultivar. In 2001, English Elm was genetically engineered to resist disease in experiments at Abertay University, Dundee, by transferring anti-fungal genes into the elm genome using minute DNA-coated ball bearings. However, there are no plans to release the trees into the countryside. Even resistant cultivars can become infected, particularly if the tree is under stress from drought and other environmental conditions, and if the disease pressure is high.

Miriam Ehret