INTEGRATED PEST MANAGEMENT (IPM) IN ORNAMENTAL HORTICULTURE

A guide to a well-planned crop protection strategy for your business

With the IPM Ornamentals Checklist

PCS

Landbouw en Visserij

This IPM guide is a PCS publication and was created within the ADLO project 'Integrated Crop Protection in Ornamentals', carried out by PCS in cooperation with ILVO.

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File number: D/2014/13.378/1
Published by: Bruno Gobin (PCS),
Schaessestraat 18, 9070 Destelbergen, Belgium

You can find a digital version at www.pcsierteelt.be.

FOREWORD

Our innovative Flemish ornamentals sector is a pioneer in many areas in the horticulture sector. Thanks to years of cooperation between the Department of Agriculture and Fisheries (ADLO) and Ornamental Plant Research (PCS), we have been able to demonstrate many good crop protection techniques in the sector. The new Integrated Pest Management (IPM) regulations have been in force since 1 January 2014. These regulations are based on eight basic principles, the aim of which is to implement a more planned crop protection strategy in all agricultural and horticultural sectors. Many IPM techniques are already commonly used on ornamental nurseries, thanks to the efforts made in recent years. Just think of the Warning System, scouting with sticky traps or the ADLO demonstration project 'Integrated Crop Protection in Ornamentals'.

In this guide, you will find a compilation of the practical implementation of the eight principles of IPM, based on the series of articles by PCS and ADLO that appeared monthly in Floriculture & Landscaping in 2013. In future, we will continue to publish the latest applications and techniques in this professional journal. Here you will find some tips on how to apply IPM on your nursery, with reference to the most currently used techniques in our sector. This guide is not a strict manual, but is intended as a guide to rational crop protection on your nursery. The IPM checklist for ornamentals shows you how to comply with the regulations.

We are happy to help you with the practical implementation on your nursery.

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INTEGRATED PEST MANAGEMENT (IPM) IN ORNAMENTALS

Integrated pest management (IPM) has been compulsory in agriculture and horticulture, including ornamental horticulture, since 1 January 2014. IPM is based on eight basic principles and allows the grower to control pests, diseases and weeds in an ecologically and economically responsible and effective way. The basic principles and corresponding measures for ornamentals are explained in detail in this guide. We start by defining IPM. In the following chapters, each IPM principle is discussed in detail. We end with a brief overview of the IPM legislation and the IPM checklist for ornamentals.

THE 8 PRINCIPLES OF IPM

IPM is the judicious combination of all plant protection techniques, with minimum risk to people and the environment, keeping crop damage and the costs of plant protection within economically acceptable levels.

I PREVENTION RATHER THAN CURE

II LOOK TO KNOW

III TREAT ONLY WHEN NECESSARY

IV KEEP CHEMICALS AS THE LAST OPTION

V CONTROL SELECTIVELY

VI RESPECT THE RECOMMENDED DOSE

VII DO NOT GIVE RESISTANCE A CHANCE

VIII RECORD AND LEARN

From European to Flemish Directives

In 2009, a European Directive (2009/128/EC) was issued that created a framework within which EU member states had to develop actions for the sustainable use of plant protection products, with IPM being one of the action points. In Belgium, the regions developed practical guidelines for each sector. These were approved by the European Commission at the end of 2013, and came into force on 1 January 2014. This means that ornamental plant growers are now obliged to cultivate within the Flemish IPM guidelines for ornamentals, summarised in the so-called IPM checklist for ornamentals.

IPM defined

The IPM checklist for ornamentals contains measures that growers can or must apply in order to achieve IPM. Therefore, it is important to understand what IPM is all about. Although there are many definitions of the term, IPM can be summarised as **the judicious combination of all crop protection techniques, with minimum risk to humans and the environment, keeping crop damage and the costs of crop protection within economically acceptable levels**. Since most ornamental plant growers are committed to growing healthy plants in an economically responsible and sustainable manner, IPM is a measure that is often already applied on the nursery (un)consciously and/or to a limited extent.

IPM in eight steps

In order to translate IPM into practice, eight general basic principles are defined, which together form an IPM roadmap that is described briefly below.

I Prevention rather than cure

Prevention of **pests (harmful insects, pathogens causing diseases and weeds)** is the basis for successful and sustainable crop protection. In addition to good nursery hygiene and the application of appropriate production methods, you should bear in mind that healthy, non-stressed plants are less susceptible to diseases and pests.

II Look to know

Since the presence of pests is sometimes unavoidable, it is important to regularly inspect your crop (monitoring), identifying any problems and following up on them over time. After all, you can only solve problems if you are aware of them in good time.

III Treat only when necessary

Depending on the crop, the presence of a pest may be permissible up to a certain level, which we call the damage threshold. If the population of the pest is smaller than this threshold, intervention is of no added value. Although crop-dependent, the damage threshold for many pests in ornamental plants is often very low to zero. The decision to treat is always based on monitoring (step 2) and your damage threshold.

IV Keep chemicals as the last option

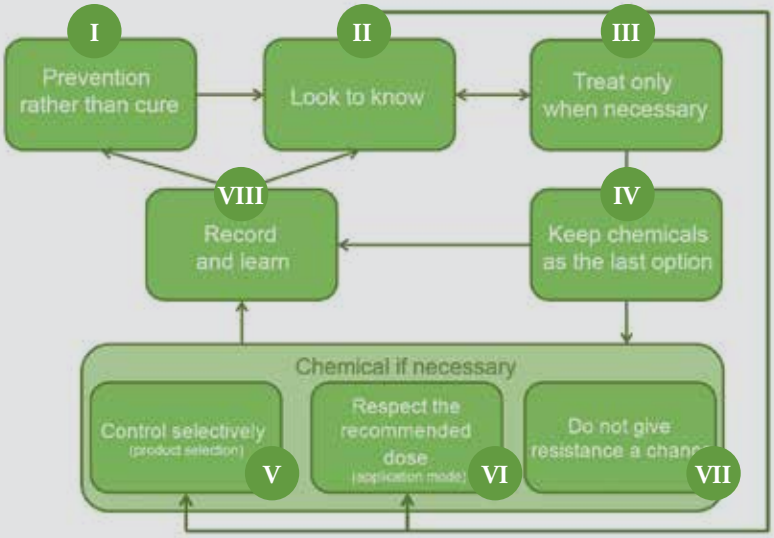
If you decide that treatment is necessary, first check whether non-chemical, economically viable alternatives are available. Bioprotectants, physical measures or biological control agents can often successfully control or contain pests, and are preferable. Of course, the use of chemicals is not prohibited and is often necessary. When selecting a chemical control, consider the following three steps to make and keep your control effective.

V Control selectively

When choosing your product, again look carefully at the situation in your crop (monitoring and damage threshold). Select a product that is both target-specific and safe, i.e. the product controls the present stage of the pests effectively and has minimal negative effects on the crop, natural enemies and ‘humans and the environment’.

In the integrated control of willow leaf beetles, the focus is on the right treatment time (steps 2 and 3) and the optimal use of the available natural enemies (steps 4 and 5).

INTEGRATED PEST MANAGEMENT (IPM): STEP BY STEP APPLICATION OF THE EIGHT IPM BASIC PRINCIPLES



VI Respect the recommended dose

In addition to the correct product choice, correct application ensures effective control. Apply the recommended dose using the correct spray application method under optimal conditions. To further reduce the use of chemicals, you can carry out a spot treatment for local problems.

VII Do not give resistance a chance

A third and final point of attention in chemical control is avoiding or delaying the build-up of resistance. To do this, alternate products from different resistance groups and respect the interval time between treatments. Every year PCS produces posters covering 'Approved products in protected ornamental horticulture' and 'Approved products in outdoor ornamental horticulture' (including the selectivity, resistance group, recommended dose and side effects of approved products) that can help you carry out chemical treatments according to principles 5 to 7.

VIII Record and learn

Finally, it is necessary to record all treatments (steps 4 to 7) and the treatment outcome obtained and to link them back to prevention and monitoring on your nursery (steps 1 and 2). Based on the records, you can make a correct evaluation of your nursery-specific combination of techniques and optimise them. The IPM step-by-step plan allows you to protect your crops in a sustainable, economically sound and effective way - often through minor adjustments - while growing high-quality plants.

INTEGRATED PEST MANAGEMENT (IPM) IN A NUTSHELL

"IPM is the judicious combination of all crop protection techniques, with minimum risk to humans and the environment, keeping crop damage and the costs of plant protection within economically acceptable levels."

Weeds on the nursery can be a source of pests, so remove them as soon as possible.

I

1st IPM PRINCIPLE 'PREVENTION RATHER THAN CURE'

Even before IPM, various principles and associated measures were already being applied in practice. Simply because it is about obvious things, such as prevention. It is always easier to prevent problems than to cure them. Welcome to the 1st IPM principle: 'Prevention rather than cure'.

How to prevent pests in your crop?

Many measures fall under the 1st IPM principle. They can be divided into three main groups: good nursery hygiene, healthy plants and the use of appropriate production methods to prevent pests. Ornamental horticulture is a very diverse sector (indoor versus outdoor production, soil versus substrate) and, as a result, not all measures will be applicable to every nursery. It goes without saying that IPM legislation also takes this into account, and only imposes the measures that relate to your type of cropping. The various preventive measures are briefly listed and explained below.

Good nursery hygiene

A tidy nursery not only gives a professional appearance, it also helps you to avoid a lot of problems. IPM starts by keeping pests and pathogens out through:

- The use of **clean pots, cutting or sowing trays**. Reuse is possible if there is no risk of contamination or if the containers are properly cleaned and disinfected first.
- **Protected storage of substrate and soil improvers**, preventing, for example, weed seeds from getting into the substrate or a loss of quality of the substrate.
- **Storage or handling of waste heaps** (crop residues, excluding pruning wood or substrate).
- The **use of disinfection mats and overalls** in indoor crops with a high risk of contamination, which can significantly reduce the risk of transmitting pests via visitors.
- **Keeping uncultivated strips free of weeds** (preferably mechanically), including the area under benches or gutters in the greenhouse. Weeds are not only undesirable because they can spread seeds, they also provide ideal hiding places for harmful insects and are often host plants for various plant diseases. Therefore, it is important to remove weeds not only in your crop, but everywhere on your nursery.

If pests are nevertheless present, the following simple measures can help you to prevent or limit further spread on the nursery:

- **Remove diseased plants (residues)** if they cannot be treated or if the removal of a few affected plants makes further treatment unnecessary, or more effective.
- **Clean and/or disinfect tools** and machinery regularly.
- Always carry out your treatments **from healthy crops to affected crops**, as human transmission is one of the main sources of infection.
- Follow the **regulations for quarantine organisms**. If you find quarantined organisms, it is important to notify the relevant authorities in order to suppress further spread quickly and effectively.

Healthy plant material

Healthy plants not only look better, they are also less susceptible to pests. Growing healthy plants starts with the choice of your crop. For some crops, resistant or tolerant cultivars that are less susceptible to certain diseases or pests are available. In azaleas, tests at the PCS and ILVO have shown that some cultivars are less susceptible to tarsonemid mites than others, while *Buxus* cultivars can differ greatly in their susceptibility to *Cylindrocladium buxicola*. If you have several varieties or cultivars in your product range, you can also opt to no longer cultivate the most susceptible ones, which can significantly reduce the infection pressure on your nursery. If it is not possible to exclude them from your range, it is recommended to closely monitor the most susceptible species or cultivars and, where necessary, to give them an appropriate preventative treatment. Are you buying seed or planting material? If available, opt for **planting material with a phytosanitary label or certificate** and **check the incoming material** for the presence of harmful organisms.

Every grower strives for efficient and high-quality production by choosing the **optimal nutrition, irrigation, drainage and growing environment**. This is also very important within an IPM system, as optimal production gives the greatest chance of healthy plants. Plants that are weakened or under stress are - like humans - much more susceptible to diseases and pests. To ensure a balanced nutrition, a **regular analysis of soil, substrate or irrigation water** is recommended. It is also important to ensure good irrigation: plants that are too dry can be more susceptible to spider mites, among other things, while plants that are too wet are more susceptible to root fungi.

> "Healthy plants not only look better, they are also less susceptible to pests."

There is a great variation in the susceptibility of plants to disease, so give preference to less susceptible species or cultivars.

Flower margins are a source of biodiversity, which increases the chance of attracting beneficial insects.

Appropriate production methods for the prevention of pests

As a third option, there are also production methods that minimise the number of pests at the start or make it easier to control them during cultivation.

For field-grown crops susceptible to soil-borne parasites, **crop rotation, fallowing areas** or **sowing of *Tagetes* or Japanese oats** (both specifically against the root lesion nematode) can reduce pest pressure. However, it is important that the field is kept free of weeds so that the parasites cannot survive on the weeds. By breaking up compacted layers or implementing structure-enhancing measures, you get **good soil water management**, which greatly reduces the risk of root diseases due to waterlogging. For protected production, it is important to adjust the irrigation applied to the crop and the climate in the greenhouse.

With field-grown crops you can also minimise weed problems during production by **creating a stale seedbed,** allowing the weed seeds that are present to germinate and these can then be removed mechanically before planting the crop.

To make it easier to control pests during production or to allow spot applications, it is useful to **plant your crop in such a way that row treatment is possible afterwards**.

A final appropriate production method for preventing pests is to **promote the biodiversity** on your nursery and to **protect the natural enemies already present**. Natural enemies are organisms that suppress pests and can occur naturally or be introduced as biological control agents. When there are many different species of insects on or around the nursery, beneficial insects or natural enemies are more likely to occur. In addition, a harmful species is less likely to develop into a real pest if it faces more competition from other species. Biodiversity in outdoor crops can be promoted by maintaining natural shelters such as **mixed hedges, wild vegetation strips and by sowing green manure or ground cover crops.** Hanging **nest boxes** to increase the number of insect-eating birds on the nursery also falls under this measure. With indoor crops, beneficials can be maintained by providing **shelter plants**: these are plants in which the beneficial insects can take shelter and where they can feed at times when no pests are present in the crop.

Good nursery hygiene and regular cleaning of equipment can limit the spread of pests.

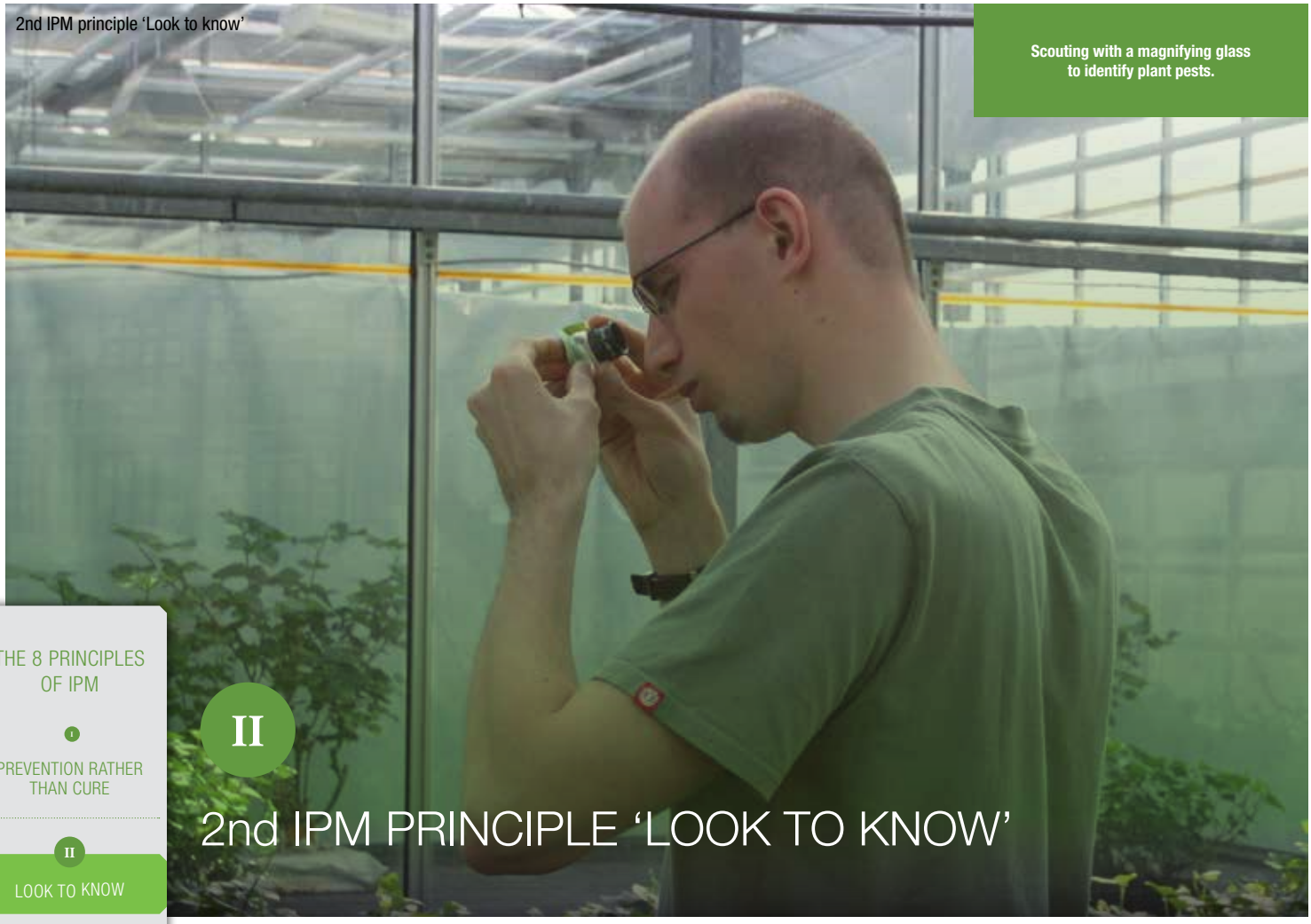
I

PREVENTION RATHER THAN CURE by:

· good nursery hygiene

· healthy plant material

· appropriate production methods



Scouting with a magnifying glass to identify plant pests.

II

2nd IPM PRINCIPLE 'LOOK TO KNOW'

In practice, every grower has to deal with pests on his nursery. It is unrealistic to think that prevention (1st IPM principle) will completely solve the problem, but it can be a big step in the right direction. If the disease or pest pressure is lowered through prevention, it will also be easier to control the pests present. How to check whether prevention is working and how to detect the presence of harmful organisms quickly and efficiently is explained below. The 2nd IPM principle 'Look to know' forms the basis for all subsequent steps within IPM.

Why is scouting so important?

The idea behind the 2nd IPM principle is actually quite simple: you can only solve a problem when you understand it sufficiently well. By regularly checking your crop for the presence of pests (also called scouting or crop walking), you can use plant protection products more effectively.

The key words here are **correct identification** and **monitoring over time** the pest population dynamics. Correct identification is important because some symptoms may have multiple causes, ranging from the presence of certain pests to a lack of specific nutrients or plant stress. Population dynamics refers to both the degree of damage (number of pests) and the stage of the pest (e.g. occurrence of eggs, larvae and/or adult pests). Some plant protection techniques or products are only economically viable after a certain degree of infestation or are only effective against certain stages.

Without proper monitoring of the pests present, you may be treating with the wrong product and/or at the wrong time. This results in unnecessary costs, both of the applied product, and the time used for application. Moreover, the risk is that the pests present will spread further, as a result of which

more plants will have to be treated, several treatments may be necessary or - in the worst case - a treatment will no longer be possible. Finally, the risk of resistance build-up to plant protection products and the additional environmental burden of ineffective treatments should not be underestimated.

Scouting as a full-fledged task on the nursery

When growers are asked how they scout, 'I'm working on my crop every day so I'm scouting all the time' is a common reply. Looking alone, however, is not enough... To 'know', you must have enough background knowledge to correctly identify what you see and you must monitor the damage or pest over time. This is the only way pest detection can serve as a basis for the efficient and correct application of plant protection techniques and products. Scouting is therefore a full-fledged task on the nursery and should be planned accordingly.

First of all, it is important to have one or more 'crop walkers' on the nursery. A crop walker has sufficient knowledge about potential pests and damage symptoms on the crop. Based on the scouting, they can make further decisions on whether or not to apply plant protection products (as described in the following IPM principles). They are also the point of contact for other staff members who notice crop damage or a pest.

Then you have to decide when to scout. Since many growers are indeed busy with the crop on a daily basis, it is not a bad idea to make use of this. Why not integrate scouting partly into your activities without having to interrupt them? This can be done, for example, by setting up a system where affected plants are clearly marked (e.g. by placing a flag near the infected plant). At the indicated locations, the damage or pest present can be further monitored. In addition, a specific time for scouting (e.g. weekly checking of the crop and insect traps on the nursery) can also be scheduled.

Finally, it is essential to monitor the observed damage or pest over time. This way you can easily see whether the problem is increasing or decreasing. 'Hotspots' can be detected where the problem recurs year after year. This can be both location-dependent (e.g. one side of the greenhouse where pests frequent fly in or a less well-drained field), and crop- or variety-dependent. With this knowledge, a decision can be made to scout extra susceptible areas or to remove susceptible varieties from the range. Moreover, a subsequent follow-up shows how effective the control measures are.

A pheromone trap or yellow sticky trap: ideal tools for detecting flying insects.

> "Why not integrate scouting into your activities without having to interrupt them? This can be done by setting up a system where infected plants are clearly marked."

Scouting tools

The easiest way to detect pests is to **visually inspect a number of random plants**. It is important to always look at the entire plant to detect the presence or symptoms of diseases and pests to which your crop is susceptible. Many pests have a preference for a specific place on the plant. Hard scale insects can be found on twigs as well as on the top and bottom of leaves, while soft scale insects prefer the underside of leaves. The underside of the leaf is also a favourite spot for spider mites and whiteflies. Aphids are found mainly in the growing points of plants, in contrast to mealybugs that are found mainly in the axils and deeper in the crop. The first symptoms of insect infestations

NEED HELP WITH YOUR SCOUTING?

Becoming a member of the Monitoring and Warning System or calling on the Crop Protection Advisory Service can go a long way in helping you. More information on both services can be found at www.pcsierteelt.be.

PCS ADVIESDIENST gewasbescherming

waarnemingen waarschuwingen

You can learn how to recognise pests on sticky traps via the Crop Protection Advisory Service.

or foliar pathogens can often also be seen on the upper leaf surface along with caterpillar and beetle feeding damage. With the help of a white piece of paper, you can tap out aphids in growing points and on leaves or thrips larvae by tapping flowers. For most insects and mites, a magnifying glass or magnifier with 15x magnification is an indispensable tool. Other tools that facilitate scouting are briefly described below:

- Yellow and blue sticky traps on which flying insects stick. The yellow traps are the most frequently used because they attract a very wide range of insects (thrips, aphids, whiteflies, leafhoppers, adult leaf miners etc.) and are relatively easy to assess. The blue traps are less bold in colour (which makes identification of the insects more difficult) and attract mainly thrips. The advantage of the sticky traps is that you not only see which insects are present in the crop, but you also get a good idea of the number of insects and can thus monitor the population over time.
- Trap lamps for spotting moths in the greenhouse. The disadvantage of this method is that the species are difficult to identify because the insects often burn when they come into contact with the lamp. The advantage is that such a lamp - in addition to being an aid to scouting - can also catch a lot of insects. To prevent a mass infestation, make sure the lamp is only turned on when the vents of the greenhouse are closed.
- Pheromone traps to catch moths. Pheromones are species-specific odours used by insects to find a mating partner, for example. By combining it with a delta or funnel trap, certain species are lured into the trap and their presence can be detected very quickly. There are also pheromone traps or lures for western flower thrips and citrus mealybugs.
- Cross vane panel traps to catch (flying) beetles in outdoor crops. These cross-shaped traps are smeared with glue and attract insects mainly by their colour.
- Soil traps to catch crawling insects.

> "For most insects and mites, a magnifying glass or magnifier with 15x magnification is an indispensable tool."

Advice and guidance

As you can read above, scouting is much more than just looking. Knowing what you see is not always easy and requires a lot of knowledge, experience and time. But don't let this put you off! You will rapidly build up the necessary experience to quickly and correctly identify and follow up on the most common pests on your nursery.

Educating yourself through various information activities on pest recognition and IPM in general is a must. This will expand your knowledge and make scouting easier. In addition, you can also call on the following institutions for advice and guidance:

Also look at the underside of the leaves, a favourite spot for spider mites and whiteflies, for example.

During the guided tours of the Warning System, you learn to recognise pests and make the right diagnosis.

· Qualified advisor or crop specialist.
· Ornamental Plant Research (PCS): Be sure to visit the website regularly. In addition to demo activities and study days, you will also find a lot of additional information such as information sheets and newsletters on pests and their control.
· ADLO (Department of Sustainable Agricultural Development, Flemish Government).
· Monitoring and Warning System (PCS): targeted pest control advice for tree growers and landscapers. The Warning System notifies when pests are detected and their control at a particular stage, even before damage is visible. In addition, you will receive independent advice on the most environmentally friendly pest control methods and, in case of doubt, you can always bring in samples of the pests.
· Crop Protection Advisory Service (PCS): assistance with scouting for growers of ornamental crops and possibly customised training for businesses.
· Diagnostic Centre for Plants (ILVO): identification of pests.

Contact details for the institutions mentioned can be found at the end of this guide under ‘Useful addresses’.

II

LOOK TO KNOW by:

· integrating scouting into your work plan
· making use of tools
· seeking training and/or advice

Treat chrysanthemum white rust preventively, i.e. as soon as the temperature and relative humidity rise and the risk of infection is real.

III

3rd IPM PRINCIPLE 'TREAT ONLY WHEN NECESSARY'

Crop protection is expensive and time-consuming. To minimise the number of crop protection treatments and optimise their efficacy, the choice of the right treatment time is crucial. The 3rd IPM principle therefore reads: 'Treat only when necessary'.

No calendar spray applications

Choosing the right time to treat is very important. Treatments applied at the wrong time are less effective, so they have to be repeated. Sometimes they are even completely useless, for example because the targeted pests were simply not present, or were present at an non-susceptible stage. Such treatments are not only a waste of money and time, they also expose the grower and the environment to unnecessary risks and may accelerate resistance.

Fixed time treatments or 'calendar spray applications' are therefore out of the question. The decision to treat is primarily based on the presence of pests (harmful insects, diseases or weeds) and the occurrence of climatic conditions that may be favourable to the outbreak of certain pests or diseases (e.g. temperature range). Often, exceeding a certain number of individual pests - also called the (economic) damage threshold - is the signal to treat. **Correct identification of the pests on the nursery and monitoring of the population dynamics over time (2nd IPM principle) are therefore indispensable for the application of the 3rd IPM principle "Treat only when necessary".**

Damage thresholds in ornamental crops: a complex case

Although the guideline 'Treat only when necessary' sounds very logical, it is one of the most difficult and abstract principles in the IPM story. The term **'economic damage threshold'** originates from the food and industrial crop sector. Here, it is possible to calculate the effect of a growing pest population on crop yields and put it into a mathematical model. The model then determines the economic damage threshold, which is the **number of pests that must be present for the**

cost of treatment to be less than the yield loss caused by that pest. Only when this threshold is exceeded is treatment (economically) viable.

In the ornamental plant sector, however, the calculation of the damage threshold is much more complex: visible damage has an immense effect and can reduce the value of the crop to zero. Crop yield is not calculated here as the volume of harvestable product per hectare, but with a much more subjective and therefore difficult to measure 'ornamental value' and plant quality. Therefore, there is very little literature and applicable knowledge on damage thresholds in ornamental crops.

The various factors that influence the damage threshold and that you, as a grower, should take into account to determine the right time to treat are briefly discussed below.

Differences in pest susceptibility within the range of crops grown

The ornamentals sector is characterised by great diversity: between crops, and even between cultivars, there can be great differences in susceptibility to a particular pest or disease. *Platanus*, for example, will not easily be damaged by rust mites, but species such as *Carpinus* and *Tilia* are very susceptible to them. The presence of thrips on the cut rose cultivar 'Avalanche' is immediately noticeable by the brown spots on the white flowers, whereas damage on the flowers for example of the orange cultivar 'Colandro' can only be seen when the thrips population is much higher. There is also a big difference in thrips sensitivity among houseplants: *Cordyline* should be treated as soon as only one thrips is observed on the sticky traps, whereas with *Hedera helix* you can safely wait until more than 10 individuals are visible. Because most ornamentals businesses grow a diverse range of species and/or cultivars, the grower must always take these differences in sensitivity into account. Susceptibility to a pest or disease is different for each crop and/or cultivar.

Other crop-specific properties

Since only the flower stem of cut gerberas is sold, the grower can accept a higher damage threshold here on the leaf than for example rose growers, who market their flowers with leaves. A similar variation in damage thresholds can be found between perennial and annual crops, deciduous and evergreen plants or between plants that will remain on the nursery for some time (and will be cut back again, for example) and those that are ready for sale.

Treat at the right time: early stages of mealybugs (transparent to pink) are more susceptible than the adult (white).

Aphids do not cause damage on *Castanea sativa*. treatment is not necessary here.

Production system

A nursery that uses natural enemies for biological control of a certain pest will have to tolerate a higher damage threshold temporarily when this pest 'appears' than a grower who uses chemical treatment. After all, the natural enemies must be given the chance to build up a sufficiently large population before they can control the pest. Correcting too quickly with a chemical product (with possible negative effects on the natural enemy) can unnecessarily increase the costs for the grower.

As a member of the Warning System, you will be informed about possible outdoor pests and the right time to treat them.

Available control methods

Not all available plant protection products work against all stages of a pest. If you want to use a product that is only effective against larvae, there is no point in treating if there are mainly eggs on your crop. This again shows the importance of good scouting.

Environmental factors and preventive treatments

Preventive treatment is sometimes the only option to ensure disease-free production or to avoid the need for intensive treatments at a later date. These **preventive treatments are fundamentally different from calendar spray applications** (= treating at fixed times): preventive treatments are carried out **at a time when the prevailing climatic conditions** (e.g. temperature, relative humidity) indicate that the risk of outbreak of the disease or pest is real and, consequently, they are not superfluous.

This can be seen, for example, in the preventive treatment of cuttings of *Botrytis-susceptible* houseplants during the dark winter months. Because of the high relative humidity in the propagation tunnels, the little light and the slow rooting in this period, the chance of *Botrytis* is very high. In other crops, too, fungi are often the cause for preventive treatments and it is important to take the climate into account. If the weather is dark and damp, treatment against fungal diseases will be necessary more quickly than in dry weather when there is less available moisture. Even when only preventive means are available (e.g. against *Cylindrocladium buxicola* on hardened *Buxus* or against white rust on *Chrysanthemum*), you must consider environmental factors that stimulate disease or pest development. Calendar spray applications with such preventive products will increase the chances of resistance, making it even more difficult to control these diseases.

Damage symptoms

Visual damage symptoms on the crop usually follow the presence of any pest or disease. Research by PCS and ILVO carried out on tarsonemid mites on azaleas showed that by the time mite damage was clearly visible, the surrounding, apparently unaffected plants, were already infested. It is therefore important to monitor the population closely, to intervene in time - preferably before any visible damage occurs - and preferably to treat the surrounding plants as well.

Nursery-specific decisions

Since the need for treatment depends on various factors, the right time to act is difficult to define in general guidelines. Most importantly, the decision to treat is always made on the basis of the presence of pests or diseases (2nd IPM principle) and/or the environmental factors that may or may not be favourable for the development of a pest or disease. To determine the damage threshold for your crop and nursery, **you combine the results of the scouting with your own growing experiences** and (personal) quality requirements. **Professional advice** (advisor, Crop Protection Advisory Service, Monitoring and Warning System, etc.)

> "IPM is also a preventive treatment at a time when the risk of an outbreak of a difficult to control pest or disease is real."

can help you better assess the situation on your own nursery. Messages from the Warning System provide information, for example, on the possible presence of outdoor pests and diseases and the right time to treat them.

Since a lot of research is currently being done on damage thresholds of different ornamental plant species for the most common pests and diseases, it is also worthwhile attending regular **events and activities**. New results are for instance presented at the annual PCS and ADLO study days for each sub-sector.

> "Most importantly, the decision to treat is always made based on the presence of pests (2nd IPM principle) and/or the environmental factors that may or may not be favourable for the development of a pest or disease."

Finally, we would like to point out the importance of a proper recording of all applied crop protection treatments and their results (8th IPM principle 'Record and learn'). **By evaluating previous treatments, you can optimise the nursery's crop protection system and better estimate when the damage threshold for a particular pest is exceeded.**

III

TREAT ONLY WHEN NECESSARY by:

· not undertaking calendar spray applications

· applying nursery-specific damage thresholds

· scouting to see if the damage threshold has been reached

Roller traps (available in different sizes) can catch a lot of flying insects.

IV

4th IPM PRINCIPLE 'KEEP CHEMICALS AS THE LAST OPTION'

As already discussed, IPM starts with good site hygiene and preventive measures to minimise the presence of pests on the nursery (1st IPM principle). We then regularly check the crop for pests and/or damage (2nd IPM principle) and - if necessary - determine the right time to treat (3rd IPM principle). The next step in this integrated approach is to choose the optimal crop protection technique, with our preference for non-chemical control. This is the 4th IPM principle: 'Keep chemicals as the last option'.

IPM is not synonymous with organic production

Contrary to popular belief, IPM does not equate to 'biological control'. The use of chemical plant protection products is still an option, but IPM requires growers to consider alternative methods as well. In doing so, you must always take into account the specific characteristics of your nursery (size, product range, available labour force, available equipment, etc.) and the cost of the technique. Therefore, you will never be obliged to use a crop protection technique if it is not practically applicable or economically viable for your nursery. If the cost of two techniques is comparable (in the long run), as an IPM grower you will naturally select the method with the least risk for yourself and the environment and with the least possible side effects on natural enemies. The various non-chemical methods (physical control, bioprotectants, biological control agents) are briefly discussed below.

Physical methods

Physical crop protection techniques range from very simple (e.g. pulling out weeds) to quite complex (e.g. UV disinfectant).

- **Manual removal of weeds, insects and diseased plants or plant parts.** Although this method can be very time-consuming, it is very effective. Grower's tip: If you have to wait a while among the crop, use this 'lost' time to remove weeds and affected plants and plant parts. Also provide some waste bins/buckets in which you can

> "Combining various pest control techniques leads to a reduction in the use of chemical products, so that they can be used longer and more effectively."

deposit the affected material immediately (away from healthy plants). Every little bit helps!

- **Mechanical weed control** is a good alternative to herbicide treatment and easy to apply between rows in field-grown crops. For container-grown crops, the use of mulches on the pots can minimise the use of herbicides.
- **Trapping of insects** can be done with the help of **roller traps, trapping lights and high-density traps** also used in scouting. Pear blight beetle (*Xyleborus dispar*) in field-grown crops can be observed, as well as caught, with a red cross trap plus alcohol pot: 1-2 traps/ha for scouting and 8 traps/ha for pest control. The yellow sticky traps that are used in protected crops for scouting, can also be used at a higher density to catch mainly whitefly.
- **Disinfection of recirculation water via a slow sand filter or UV disinfection unit** is very effective to combat various pathogens and to prevent (re) contamination via irrigation water. To check whether the water is free of *Pythium* and *Phytophthora* after disinfection, a leaf trap test can be carried out. In the leaf trap test, leaves of *Rhododendron* 'Cunningham White' are placed in the water tank. These leaves actively attract the mobile spores of *Pythium* and *Phytophthora*, so that you can clearly see after 3-4 days whether the fungi are present in your water.
- **Heat treatment** is used less in practice but is useful for controlling weeds (burning), water disinfection (heating) and soil disinfection (steaming). Research at the PCS showed that immersing azalea cuttings in hot water is an effective way to reduce the pest pressure of tarsonemid mites. Correct application of the method is crucial for successful control and to avoid crop damage. Please contact the PCS if you would like more information on the applicability of this method; we will be happy to help you. Finally, the disinfecting effect of frost can also be considered as a natural physical control of insects and pathogens in outdoor crops.

Bioprotectants

Bioprotectants are defined as all plant protection products based on plant extracts, bacteria, fungi and natural oils. In the table below, you will find an overview of all bioprotectants approved in Belgium for use in ornamental horticulture. The advantage of these products is that their application method does not differ, or differs very little from that of chemical plant protection products. The step to using bioprotectants is therefore quite easy. Do not lose sight of the fact that 'natural' does not automatically mean non-toxic and safe for the crop, natural enemies, humans and the environment.

Inform yourself via the supplier, your advisor or the PCS before you apply new products on your nursery: correct application is the key to success. In case of a failed crop protection treatment (chemical or otherwise), ask yourself whether the application was done correctly: correct dosage, correct application interval with regard to earlier or subsequent treatments, good crop coverage, ideal climate conditions. This way you avoid discounting certain products unjustly.

BIOPROTECTANTS APPROVED[1] FOR USE IN ORNAMENTAL HORTICULTURE

BIOPROTECTANT BASED ON	PRODUCT NAME	EFFECTIVE AGAINST
Plant extract	NEEMAZAL-T/S	aphid, whitefly, spider mite
Various fungi	BIO 1020	weevils, beetles
	BOTANIGARD 22 WP[2] NATURALIS-L[2] PREFERAL WG[2]	whitefly
	PRESTOP PRESTOP MIX	*Botrytis, Fusarium, Pythium, Phytophthora*
	CONTANS WG	*Sclerotinia*
	TRIANUM-P[3] TRIANUM-G[3]	*Fusarium, Pythium, Rhizoctonia*
Bacteria ***Bacillus thuringiensis***	XENTARI WG DIPEL DF	caterpillar
Paraffin oil	SUN SPRAY 7E	scale insects (soft, hard, woolly), spider mite

[1] Status of recognitions on 31 January 2014 according to Phytoweb.
[2] Only recognised in protected crops.
[3] Plant enhancer: preventive effect by increasing competition with harmful fungi.

Avoid *Pythium* damage by disinfecting recirculation water using for example a slow sand filter.

Mulching reduces the use of herbicides.

Use naturally occurring control agents such as ladybirds that eat aphids.

Increase the number of traps to move from scouting to control.

Mechanical weed control is a good option in field-grown crops.

Biological pest control agents can be introduced in various ways, including blowing them over the crop.

Biological control agents

Natural enemies are organisms that suppress pests and may occur naturally or be released as biological control agents. The table on the right gives an overview of the most important groups of natural enemies and the insects they control. The use of biological control agents is perhaps the most difficult crop protection technique because there are many things to consider in order for the method to be successful. The approach is always nursery-specific. It is therefore important that you receive sufficient guidance and that you draw up a clear production plan in advance. In this production plan, you should consider, among other things:

- the environmental factors that are necessary for the biological control agent to function optimally in your crop
- the different pests that affect your crop
- the selective means or alternative methods available to control the pests that you do not control biologically
- the selective products that can be used for a corrective spray
- the after-effects of applied products

BIOLOGICAL CONTROL AGENTS

ACTIVITY	NATURAL ENEMY	EFFECTIVE AGAINST
Egg deposition in prey	Wasp	whitefly, aphid, mealybug, caterpillar, leaf miner
Adult sucks out prey contents	Predatory mite	whitefly, spider mite, tarsonemid mite, sciarid fly
	Predatory bug	whitefly, spider mite, thrips
Adult and larvae suck out prey contents	Beetle (e.g. ladybird)	whitefly, aphid, thrips, sciarid fly
Larvae suck out prey contents	Gall midge	aphid, spider mite
	Lacewing	aphid
	Hoverfly	aphid
Larvae invade prey	Insect parasitic nematode	caterpillar, thrips, snails, vine weevil, sciarid fly

"Keep yourself informed: correct application is the key to success."

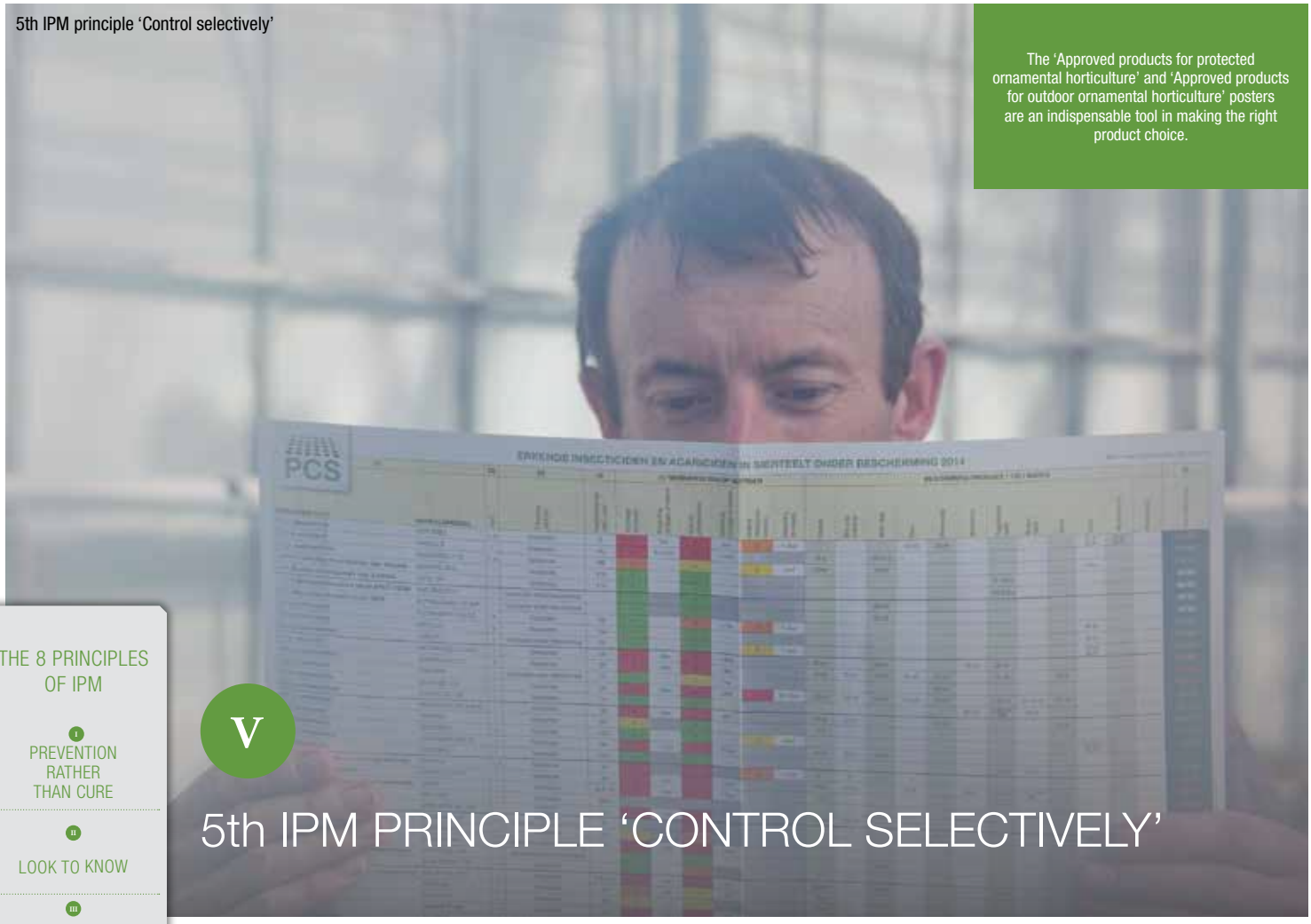
At present, the cost is still often a stumbling block in the use of biological control agents. We hope and expect that this cost will decrease in the future. The PCS already contributes to this by experimenting with lower release rates and supplementary feeding of biological control agents so that they have to be released less often (because they survive on the supplementary feed in periods of low pest pressure).

Do you want to use biological pest control on your nursery? Then be sure to check out the information available on the PCS website (including newsletters and warning messages about alternative pest control methods and action plans), and seek advice from your supplier.

IV

KEEP CHEMICALS AS THE LAST OPTION by:

- applying physical methods
- using bioprotectants
- releasing biological control agents



The 'Approved products for protected ornamental horticulture' and 'Approved products for outdoor ornamental horticulture' posters are an indispensable tool in making the right product choice.

V

5th IPM PRINCIPLE 'CONTROL SELECTIVELY'

In practice, the use of chemical plant protection products will often be the best (or only) option to control the pests on your nursery. The choice of product is the first important step in the use of chemicals. After all, optimal product selection is about more than just efficient operation.

Characteristics of an optimal product

First of all, you want a product that works well **(effectively)** against the pests we want to control **(selectively)**. Moreover, we want the product to be **safe** for the crop **(no phytotoxicity)**, for the beneficial organisms on the nursery **(minimal side effects)**, for you as a user and for your employees' health **(minimal risks)** as well as for the environment **(minimal impact)**. So, there are many factors that influence your choice of product. What do you need to look out for? Where can you find the right information? Below, we get you started on each factor and illustrate the selection process using an example of chemical spider mite control.

Selective and effective

When choosing a product, aim for one that is as target-specific as possible, which means that the product will only harm the pests you want to control. **Knowledge of the pest** is crucial here. Certain deficiency diseases can sometimes be mistaken for insect or fungal damage. In these cases, treatment will not be of much benefit. In addition to detecting and identifying the pest (2nd IPM principle), it is also important to take the life cycle of the pest into account. Control works best when the pest is at its most susceptible stage (3rd IPM principle). In addition, some products only work against specific stages, so the choice of a particular product may be strongly influenced by this.

That selective means works effectively has already been demonstrated many times. You can increase this effect even more by optimising the application of the product. Wherever possible, consider the required climatic conditions in which the product can be used, and the life cycle of the pest or disease. Finally, drawing up a **crop protection plan** can also help you to increase the efficacy of your product. By listing the pests associated with your crop and checking which control techniques are available for each, you can make more

efficient use of resources. By using selective products wherever possible, the broad-spectrum products remain available for the control of other pests for which there are no selective products. The importance of this is further explained under the 7th IPM principle 'Do not give resistance a chance'.

No phytotoxicity

The effect of a product on the crop itself is evaluated during the approval procedure of a plant protection product. For the ornamentals sector, this research is only done on four crop types from the following groups: woody deciduous, woody conifer, non-woody annual, non-woody perennial. For this reason, PCS carries out additional crop safety tests on a wide range of crops every year. Via the PCS website, members can consult the results of these additional trials on 'Phytoweb' and use them as a guide for the application of the tested products on their own nurseries.

Minimal side effects

It is best to preserve as many of the beneficials (various insects, predatory mites and birds) that occur naturally on your nursery as possible, as they contribute - free of charge - to keeping pests under control. If you use biological control agents, you also want to minimise any impact on them when you carry out a corrective or chemical control treatment against another pest. A crop protection plan can again help with this, to get an overview of the possible treatment - in combination with biological control - to keep all pests on the nursery under control. Sources about the side effects of chemical products are diverse (best known are the lists from Biobest, Koppert, IOBC, pcfruit and also the results of the annual PCS side effects study), which is why all these data are bundled in the 'Approved products in ornamental horticulture' posters. In addition, the VMS-Mind score (see below) also takes this factor into account.

CHOOSING A SELECTIVE PRODUCT

Practical example of chemical spider mite control

On the annually updated PCS posters 'Approved products for protected ornamental horticulture' and 'Approved products for outdoor ornamental horticulture', you will find all approved plant protection products for ornamentals in Belgium at a glance. Attention: approvals change every year, so make sure you always work with the latest version of the poster and/or check the approval on www.fytoweb.be.

PRODUCT NAME[2]	ACTIVE SUBSTANCE	APPROVED FOR USE IN[1]		ALSO EFFECTIVE AGAINST	
		Protection	Outdoor		
Apollo	clofentezin	x	x		**-> selective**
Envidor	spirodiclofen	x	x	scale insects and mealybug, psyllids, gall and rust mites	
Floramite 240 SC	bifenazate	x	x		**-> selective**
Masaï 20 WP	tebufenpyrad	x	x		**-> selective**
Milbeknock	milbemectin	x	[3]	**tarsonemid mites**, leaf miner	
Nissorun	hexythiazox	x	x		**-> selective**
Sanmite WP	pyridaben	x	x	whitefly, gall and rust mite	
Scelta	cyflumetofen	x			**-> selective**
Vertimec	abamectin	x	x	**tarsonemid mites**, psyllids, thrips, leaf miner, gall and rust mite	

(1) Approval status on 31 January 2014 according to Phytoweb.
(2) Only one product is given as an example, see Phytoweb for the full range.
(3) Only approved outdoors for tarsonemid mite control and not as a product against spider mite.

In January 2014, there were four selective chemical products available for outdoor crops that were specific to spider mite, for indoor crops there was one more (Scelta). It is therefore more logical to use these products if spider mites are the only issue and to save products such as Milbeknock (only under protection) and Vertimec for the control of tarsonemid mites, a pest for which there are far fewer products on the market.

Tip: Bioprotectants (NeemAzal-T/S, Sun Spray 7E) and biological control agents (predatory mites) can also combat spider mite.

Minimise health risks by wearing protective clothing, gloves and a face mask when spraying.

This, too, is IPM: store your chemical products properly, behind lock and key, so that others cannot come into contact with them.

Minimal risks and impact

Nobody likes to be exposed to toxic substances. Therefore, it is also advisable, if possible, to always choose the product with the least risk to health and the least impact on the environment (where the products can accumulate and thus enter the food chain). These factors were incorporated into the VMS-Mind score, which is further briefly discussed and illustrated.

Apart from product choice, there are some simple measures you can take to minimise the risk to humans and the impact on the environment:

> "Use selective products where possible so that broad-spectrum products remain available to control other pests."

- Wear protective clothing, gloves and a face mask when spraying.
- Although not all products can be applied this way, preferably treat in the evening or on weekend so that staff members have minimal contact with the recently treated crop.
- Products must be stored safely and in accordance with the regulations in a pesticide store or cabinet. Make sure the door is locked at all times, especially when there are children on the premises.
- Products must only be handled by people who have been trained and certificated for this purpose (compulsory pesticide licence from 25/11/2015).
- Use an approved sprayer. Only sprayers carried on the back (irrespective of the number of nozzles) and lance sprayers (max. 2 nozzles) are exempt from inspection.
- Outdoor treatments should be carried out on wind-free days whenever possible. The use of drift-reducing nozzles is recommended for field sprayers.
- Avoid point source pollution by never filling your spray tank near a drain and respecting the buffer zone for surface water when spraying outdoors and avoid waste spray solution, if necessary, by applying the diluted solution over the crop.

CHOOSING FOR MINIMUM SIDE EFFECTS
Practical example of chemical spider mite control

On the basis of the summary column 'side effects on beneficial insects' on the 'Approved products for ornamental horticulture' posters, you can find which selective spider mite products are the least harmful for example the predatory mite *Phytoseiulus* used in crop protection programmes. If the spider mite population gets too high at any time and chemical treatment is required, you can still use Apollo, Nissorun or Scelta without wiping out the predatory mite population. For outdoor crops, you will notice that your choice of product will not have much effect on naturally occurring ladybirds: all selective spider mite products are reasonably safe with this beneficial insect.

PRODUCT NAME(1)	ACTIVE SUBSTANCE	SIDE EFFECT (% REDUCTION) WITH	
		PREDATORY MITE *PHYTOSEIULUS* deployed as a biological control agent under protection	LADYBIRD naturally occurring outdoors
Apollo	clofentezin	< 25%	25-50%
Floramite 240 SC	bifenazate	25-50%	unknown
Masaï 20 WP	tebufenpyrad	> 75%	25-50%
Nissorun	hexythiazox	< 25%	25-50%
Scelta	cyflumetofen	< 25%	–

(1) Only one product is given as an example, see Phytoweb for the full range.

CHOOSING FOR MINIMUM RISK AND IMPACT
Practical example of chemical spider mite control

Based on the column 'VMS-Mind-score' on the 'Approved products for ornamental horticulture' posters, you can check the overall environmental and health impact of the various selective spider mites products with minimal side effects on - in this example - the predatory mite *Phytoseiulus* (under protection) and ladybird (outdoors).

PRODUCT NAME[1]	ACTIVE SUBSTANCE	VMS-MIND-SCORE	
		Under protection: environmental zone 3 / 4	Outdoors: environmental zone 5 / 6
Apollo	clofentezin	orange / orange	orange / orange
Floramite 240 SC	bifenazate	[2]	green / green
Masaï 20 WP	tebufenpyrad	[2]	orange / orange
Nissorun	hexythiazox	green / green	green / green
Scelta	cyflumetofen	orange / green	–

(1) Only one product is given as an example, see Phytoweb for the full range.
(2) For protected crops, this product was 'removed' from our list in the previous step because of the greater negative impact on the predatory mite *Phytoseiulus*, released under protection.

The table shows us:
- For chemical spider mite control under protection where the predatory mite *Phytoseiulus* is also used, it is best to choose a product based on hexythiazox (e.g. Nissorun) because it will only give control of spider mites (selective), do least harm to the predatory mites (minimal side effects) and has the least negative impact on our health and the environment (score green). In greenhouses where recirculation is not used (environmental zone 4), a cyflumetophen-based product (e.g. Scelta) is also a good choice.
- For chemical spider mite control outdoors, it is best to choose a product based on bifenazate (e.g. Floramite 240 SC) or hexythiazox (e.g. Nissorun).

- Dispose of empty packaging, caps and expired products via PhytofarRecover.

VMS-Mind-score

To assess the safety of a product you can use the VMS-Mind-score. 'Mind' stands for '**environ**mental **indi**cator': the score gives an idea of the possible effects of an active substance on the environment, taking into account the effect on beneficials (incl. birds, soil and water organisms) **(side effects)**, toxicity (incl. long-term effects on health) **(risk)** and persistence in the environment **(impact)**. All these effects are added up to a colour score that indicates the degree of risk and negative effects: red = high, orange = moderate and green = limited effect. Biological agents are scored white. In addition, the Mind score also takes into account the mode of action of the product. Ornamental horticulture can be divided into four 'environmental zones': zone 3 = greenhouse production with recirculation, zone 4 = greenhouse production without recirculation, zone 5 = outdoor production but not close to surface water or low groundwater level, zone 6 = outdoor production in wetlands or areas with high groundwater level. VMS members can access Mind scores online and view them in detail (scores for all individual factors). PCS members can find the overall scores (all factors combined) for the environmental zones relevant to their crops on the 'Approved products in ornamental horticulture' posters.

Additional factors that determine the choice of a chemical product are, of course, the cost and the compatibility of the product with other products if you want to control multiple pests in a single application. Finally, the resistance group of the product also plays a very important role. We will discuss this aspect under the 7th IPM principle 'Do not give resistance a chance'.

V

CONTROL SELECTIVELY
with products that:

- are target-specific
- have minimal side effects on beneficial insects
- have received a good VMS-Mind score

A shielded boom allows you to spray deeper into the crop.

VI

6th IPM PRINCIPLE 'RESPECT THE RECOMMENDED DOSE'

Now that we have selected the right chemical plant protection product (5th IPM principle), let's go a step further and see how to optimise its use. The 6th IPM principle 'Respect the recommended dose' helps you to apply plant protection products at the correct dose and with maximum efficacy.

Recommended = optimal dose

The approval system for chemical plant protection products in Belgium aims at identifying the dose that is effective ('as much as necessary') but minimal ('no more than necessary'). In principle, therefore, the recommended dose is the optimum dose and also the only one that may be used. This dose can be found on the product label, Phytoweb or the 'Approved products in ornamental horticulture' posters. Nevertheless, it is tempting to use a higher or lower dose sometimes.

If a previous treatment was not 100% successful, the temptation to apply a slightly **higher dose** the next time can be high. However, this is not permitted and not without danger: a higher dose increases the risk of crop damage and has more negative effects on beneficials, your health and the environment. In addition, you use more product and the treatment becomes more expensive. It is therefore better to respect the recommended dose and increase the efficacy of your treatment by using **the correct spray application method** under **optimal conditions**.

Conversely, after a few successful treatments, you may wonder if you can get the same result with a **lower dose**. At first glance, this does not seem a bad idea: a lower dose is cheaper and reduces the risk of crop damage and the negative impact on beneficial insects, health and the environment. However, a lower dose encourages the development of resistance because the strongest individuals in the pest population may survive the dose (e.g. because they have an accelerated metabolism). As a result, only the strong individuals multiply and their number in the population increases rapidly. So you get, as it were, an accelerated version of Darwin's survival of the fittest. So how can you reduce your total usage of chemical plant protection

> "Increase the efficiency of your treatment by using the correct spray application method under optimal conditions."

products? By selecting alternative control methods as far as possible (4th IPM principle), by treating effectively so that a repeat application is not necessary (optimal spray application method and conditions) and by **reducing the treated area** and carrying out spot applications where possible.

Optimal spray application method

A single optimal spray application method does not exist, as it is determined by many factors, such as crop, plant protection product and pest/disease. Where is the pest/disease in the crop? Is it easy to reach? Does your plant protection product have a contact effect or does it need to be consumed by the pest? Is your product absorbed by the crop or does it remain on the leaf surface? Is your crop compact? What is the plant density? ... It is therefore important that you decide for yourself and the specific situation on your nursery whether you are using the correct spray application method. There are many ways to improve your spray application method. Below are some examples. Not sure what the best choice is for your nursery? Do not hesitate to ask your advisor, product supplier, sprayer manufacturer, advisory service or the PCS for advice, and consider all the possibilities for optimising spray application on your nursery. Please note that not all methods can be applied everywhere.

Custom sprayer

For an optimal distribution of spray solution over your crop, you can opt for a sprayer that is customised to your crop, production system and needs. A simple backpack sprayer may be the perfect device for a grower who mainly wants to apply small spot applications, while a state-of-the-art spray application robot that travels between the rows and reaches both the top and bottom of the crop, for example, is the right investment for a cut-rose grower. For outdoor container-grown crops, a shield on the spray boom can allow better penetration between the plants and a vertical spray boom is more appropriate for row planted, upright crops. There are many possibilities, and methods are constantly being optimised or renewed. Are you fruitlessly searching for the optimal device for your nursery? Then contact the PCS; it may be possible to find a solution together. The Flemish Government (IWT) also supports such innovations through SME innovation projects and other subsidies.

Air assistance

An air-assisted sprayer makes it possible to get your spray solution deep into your crop and onto the underside of leaves. If you mainly use products that are absorbed by your crop and distributed via the sap flow (e.g. various crop protection products against sucking insects), air support - and the corresponding investment - is unnecessary.

Wetting agent

A wetting agent is sometimes necessary to ensure the penetration of your plant protection product. Many plants (crop and weeds) and some insects (e.g. mealybugs) have a wax layer. If you spray a drop on it, it will simply run off. The wetting agent acts on the wax layer so that your plant protection product can penetrate better. Some commercial products already include a wetting agent, with other products the agent has to be added to the spray tank separately. Check the product label for the correct information and dosage!

Lures

There are two types of lures: pheromones and sugars. For pheromones, hang the distributor above your crop a few hours before spray application. The attractant brings the male insects to the top of the crop, making it easier to reach them a little later. There are many different pheromones on the market. Consult your product supplier for the right choice. Sugar-based attractants can be sprayed in advance to draw the insects out into 'spray accessible' places within the crop so that you can reach them better with a contact agent afterwards. Thrips, for example, are strongly attracted to the sugar sprays. When applying a plant protection product that is eaten by insects, you can tank mix and apply the sugar solution with it to stimulate the insects' feeding.

Optimal (climatic) conditions

Just like the spray application method, the optimal (climate) conditions in which to carry out spraying strongly depend on the plant protection product selected, the pests to be treated, your crop and your production system. Should the product be sprayed on a wet or dry crop? How quickly is the product rainfast? Is there a risk of crop scorch from high light intensities during or immediately after treatment? What is the effect of ambient temperature and relative humidity on performance? Where is the pest? Again, the best advice is to read the product label carefully and consult professional help if in doubt. An additional tip: **record the climate conditions during and immediately after spray application** (8th IPM principle 'Record and learn') because this information can help you afterwards

Pheromones attract male insects to the top of the crop several hours before spray application.

Band spraying with an adapted device reduces your product usage.

> "Reduce your chemical usage by treating a smaller area at the correct dose."

to estimate whether these factors played a role in the success or failure of the treatment.

Minimise the treated area

Finally, you can greatly reduce your use of chemical plant protection products by treating a smaller area at the correct dose. You can reduce this surface area by treating - if possible - during or immediately after potting (e.g. spraying individual pots on the conveyor belt) or before the plants are spaced out. When you treat plants that are close together, less spray is lost but it is also more difficult to cover the crop properly. Therefore, such application is only appropriate when the pests you want to treat are present in crown of the crop, when the plant protection product is absorbed by the crop or when the plants are still small.

Spot applications are another way to reduce your treated area. This is easy to apply in weed control on uncultivated areas such as paths, under tables and gutters or in 'forgotten corners'. With good scouting, diseases and pests can also be spot treated too. Sufficient knowledge of the pest is important here. For example, when you see tarsonemid mite damage on azaleas, mites will already be on the surrounding plants. In case of a spot treatment, you should not only treat the affected plants but also a wide circle around them. Again, the advice is: if in doubt, seek professional help!

VI

RESPECT THE RECOMMENDED DOSE

but:

· use the most effective spray application method

· spray under optimal (climate) conditions

· minimise the treated area

Acaricide-resistant spider mites are becoming more common. Use IPM as a weapon in the fight against resistance.

VII

7th IPM PRINCIPLE 'DO NOT GIVE RESISTANCE A CHANCE'

Resistance has already been addressed regularly in this guide. The phenomenon is making life difficult for growers. When confronted with resistant pests on your nursery, it is sometimes impossible to control them with the available chemical plant protection products. The avoidance of this situation is therefore an important motivation to apply IPM. But here too, prevention is better than cure. The 7th IPM principle 'Don't give resistance a chance' helps you minimise resistance problems on your nursery.

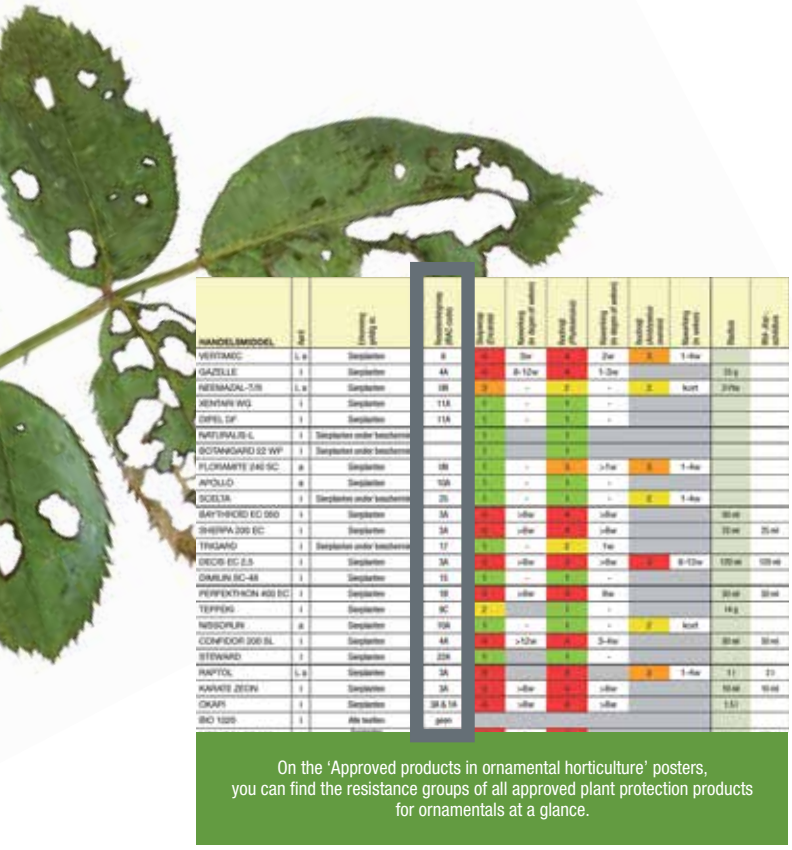
How does resistance develop?

Each plant protection product has a specific mode of action. The product is absorbed by the pest, and the substance binds with certain molecules in the cell and switches off one or more processes, causing the pests to die or to stop producing fertile offspring. Products with the same mode of action belong to the same resistance group. This group is indicated by a number and/or letter and can be found on the poster 'Approved products in ornamental horticulture'. Not sure which groups the products in your pesticide store or cabinet belong to? Then be sure to seek advice from your product supplier, your advisor or the PCS.

Although the terms are often used interchangeably, resistance is not the same as tolerance. Tolerance refers to being naturally less susceptible to a substance, e.g. because the process on which the substance acts is not of vital importance to the pests or because the product is not absorbed sufficiently (= physical barrier). Hence the importance of good scouting (2nd IPM principle) and a well-considered product selection (5th IPM principle) to correctly identify the pest and to select a product that is also effective against it.

When a pest can no longer be controlled (properly) with a product to which it is normally susceptible, you are dealing with resistance. Resistance can be roughly divided into two groups:

- **Resistance due to a modified binding site:** A mutation in the pest's DNA ensures that the plant protection product can no longer bind and is therefore no longer effective. This type of resistance can best be compared to an 'on/off switch': if the pest has the mutation, the switch goes off and even a 10-fold dose has no effect. It is important to note that these



On the ‘Approved products in ornamental horticulture’ posters, you can find the resistance groups of all approved plant protection products for ornamentals at a glance.

mutations can occur spontaneously and therefore cannot be avoided.

- **Resistance by rendering the product harmless:** The pest will no longer absorb the agent properly (e.g. more difficult to penetrate skin) or will break it down more rapidly into harmless substances (= increased metabolism). In contrast to resistance by target modification, the emergence of this type of resistance is a gradual process, somewhat similar to a vaccination. Exposure to a non-lethal dose gives the pest the chance to neutralise the substance and with each new non-lethal dose it becomes more efficient at doing so. Resistance is only said to exist when this characteristic is also passed on to the next generation. Because the dose and number of applications are important here, as a grower you have an influence on the development of this type of resistance.

Both resistance types spread in the same way on the nursery. After applying a product to which they are resistant, resistant individuals have a greater chance of survival and can reproduce, thus increasing their percentage make up in the population. Through transport of infected plant material or active movement of the pest itself, resistance can spread to other nurseries. Because many growers have similar spray programmes and some spontaneous mutations occur more frequently than others, the same resistance problem may arise simultaneously - but independently - in different places.

> “Alternating between products from the same resistance group has the same effect as repeated use of the same product: resistance increases!”

Preventing the spread of resistance

Because spontaneous mutations are often the basis of resistance, it is impossible to stop the emergence of resistance. A further increase in the number of resistant individuals in the population can fortunately be avoided! Some tips:

Integration of non-chemical methods

As the number of chemical plant protection products in ornamental horticulture is limited, the integration of non-chemical methods can help to allow more time between applications. These include use of bioprotectants for pest and disease control or mechanical weed control to replace herbicide treatment. The use of biological control agents is also a good option, although of course you have to take into account possible residues from previous applications and the availability of products with minimal side effects.

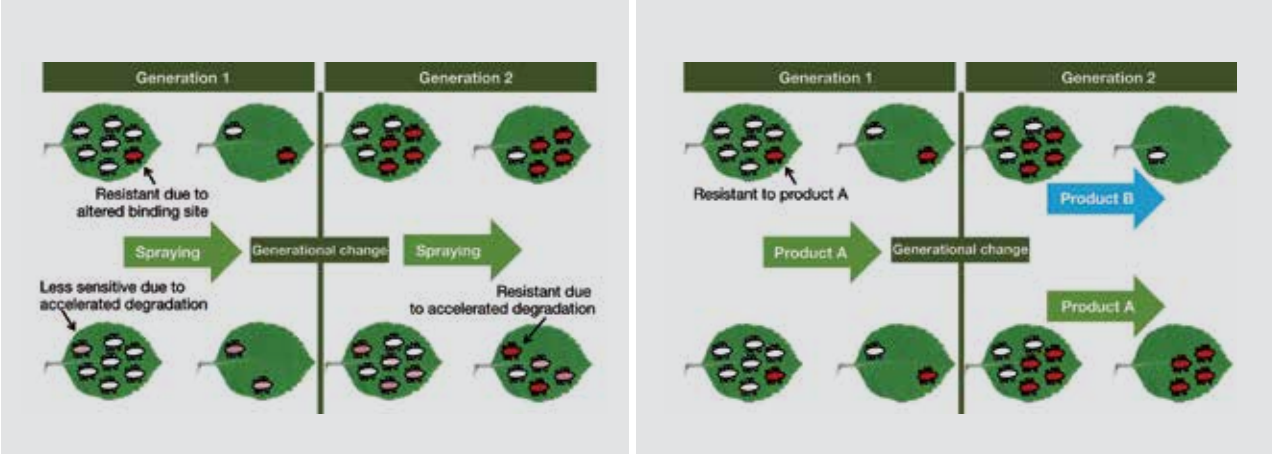
Effective control

By maximising control efficacy, the pest has less opportunity to build up a resistant population. If you consider the IPM principles as a step-by-step plan, control should be much more effective: identify (the stage of) your pest (2nd IPM principle), choose a selective and effective product (5th IPM principle) and apply it at the recommended dose and under optimal conditions (6th IPM principle). If the outcome of your pest control is not good, you should certainly ask yourself why. Did you make a mistake so that the process was not optimised, or do you possibly have to deal with resistance build-up? A good record of your treatments can help you do this.

Minimum frequency

The number of sprays you need to carry out is, of course, largely dependent on the efficacy of your control. Again, it is very important to know why a treatment may not have been successful. When resistance is the cause of the failure, repeating the same treatment is out of the question. The proportion of resistant individuals in the pest population could increase very rapidly as a consequence.

You should also be careful with broad-spectrum products, as they can impact some pests more frequently than expected. Suppose you want to control aphids, then the chances are that the product is also effective against whiteflies. This can be



Left: The proportion of resistant individuals and the degree of resistance after repeated spray applications depends, among other things, on the resistance type. Resistance through an altered binding site (=mutation) is obvious: resistant individuals are completely immune to the product or substance. Resistance through accelerated degradation is a gradual process. After exposure to a non-lethal dose (e.g. lower dose, poor spray application conditions ...), less susceptible individuals can evolve into resistant ones in a few generations. Fortunately, a spray is never 100% effective, so sometimes susceptible individuals survive and the population does not become completely resistant.
Right: To reduce the degree of resistance, you need to use products from different resistance groups (e.g. A and B) alternated. Individuals who are resistant to product A can be controlled with product B, thus reducing their numbers.

useful when you want/need to control both pests at the same time. However, when only aphids are a problem, you might not realise that the (few) whiteflies present in the crop also come into contact with the product (and can build up resistance).

> "You cannot always control the emergence of resistance, but fortunately you can control its spread through your nursery."

Alternating products in different resistance groups

Since many pests have several generations per growing season, repeated control is often necessary and the minimum frequency of treatment can be quite high. Alternating products from different resistance groups can then offer a solution. As already mentioned, all plant protection products with a similar mode of action are in the same resistance group. If a pest is resistant to one product in this group, there is a very high probability that it will also be resistant to other products in the group. This means that alternating between products from the same resistance group has the same effect as repeated use of the same product, namely an increased risk of resistance build-up. Fortunately, resistant pests are usually still susceptible - or sometimes even more susceptible - to products from another resistance group. By alternating products from different groups, you can keep resistance under control. A pest resistant to a product from resistance group A will survive and reproduce after treatment and thus increase the percentage of the population it makes up. A subsequent application of a product from Group B will kill these resistant individuals and their share in the population declines.

However, we must make two comments here. Firstly, there is 'multiple resistance', whereby pests are resistant to products from different resistance groups. In these cases, alternation becomes very difficult. Fortunately, this phenomenon is less common than single resistance. Secondly, we see that in practice, there are sometimes insufficient products available and/or approved in the ornamentals industry to be able to alternate properly. People try to resolve this by so-called **'block spraying'**. In this case, a plant protection product is applied several times in succession within the same generation (= block) and a product from another resistance group is used for the next generation. The difficulty here is knowing how long your generation will last, as it is strongly influenced by temperature, among other things. For example, the generation time from egg to egg for spider mite is 36 days at 15°C, 17 days at 20°C and only 7 days at 30°C. Please note that in many cases the number of applications (per crop or per year)

Be extra vigilant against resistance when the number of products is limited or when they belong to the same resistance group, as with tarsonemid mites.

consists almost entirely of resistant individuals, intervention is too late. An effective spray rarely kills 100% of a population, so even after applying a product from another resistance group, resistant individuals will survive and the product against which resistance exists will become useless.

"Not the desired treatment outcome? Be critical and look for the cause of the treatment failure."

with a plant protection product is legally limited. Please read the product label or the approval information carefully.

The number of chemical plant protection products available for ornamental crops is sometimes quite limited. Unfortunately, it is likely that more products will disappear in the future compared with the development of new products or resistance groups. That is why it is so important that we use them sensibly and do not give resistance a chance. When the pest population

VII

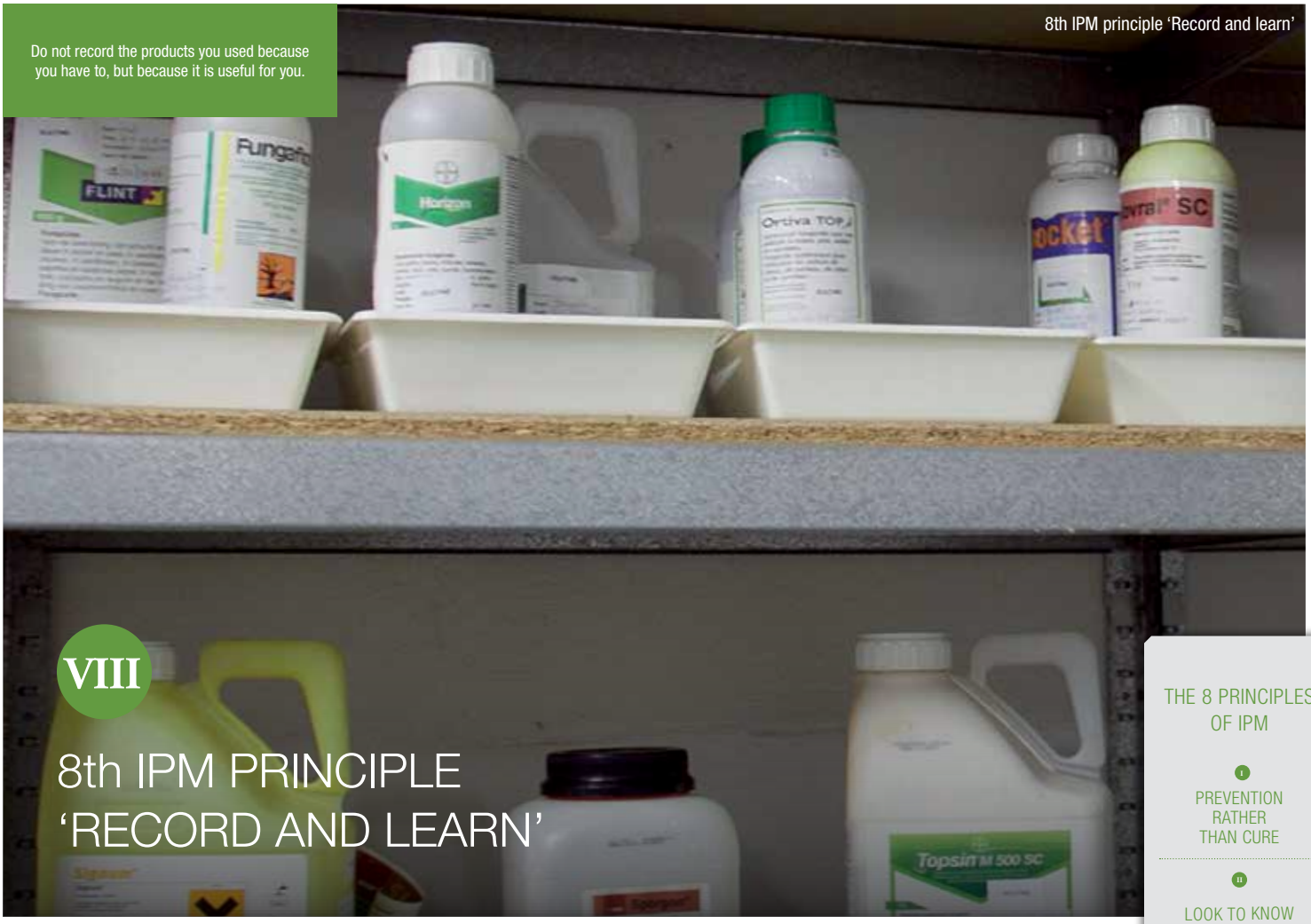
DON'T GIVE RESISTANCE A CHANCE through:

· effective treatment

· a minimum application frequency

· alternating between products from different resistance groups

Do not record the products you used because you have to, but because it is useful for you.



VIII

8th IPM PRINCIPLE 'RECORD AND LEARN'

The 8th and final IPM principle is 'Record and learn'. Which recording is required by law? What additional information can you record? What is the point of recording? You will find out below.

What does the law say?

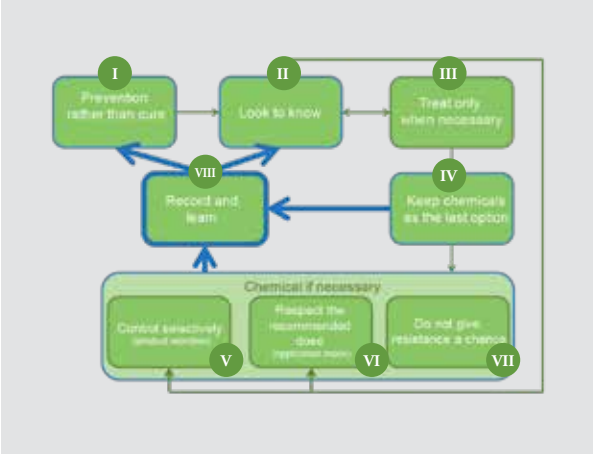
Since June 2011, all ornamental plant growers are obliged to keep a record of their use of plant protection products (FAVV, Regulation 1107/2009). The record must be kept for three years, and contain the following information:

- product used (full trade description)
- date of application
- description of the crop treated
- location of the crop treated (greenhouse/plot no. ...)
- dose used

The way in which you record is not specified: you can choose whether you do this in a diary, on a paper form, in an Excel file or in any other way. Growers who are members of the Flemish Environmental Plan for Ornamental Plant Production (VMS) can also use MPS's extensive recording module. The law does not specify how to record the dose. If you want to make use of the information, you should record both the applied concentration (e.g. mg or ml of product per litre of spray solution) and the applied rate (e.g. number of litres of spray solution per m^2 or ha). The IPM checklist for ornamental crops does not contain any further recording obligations (only the requirements of the FAVV remain in force) but it does give some recommendations for a more extensive recording, namely noting the reason for treatment, any non-chemical crop protection and the result of the control.

Record for your own purposes

Perhaps the most important message of the 8th IPM principle is: do not record because you have to, but because it is useful for you. As mentioned at the beginning of this guide, IPM is a step-by-step plan. By recording as much information as possible about the decisions made in earlier steps (from scouting results to product selection), you can easily assess your own strategy and act on the positives and deficiencies. This is the only way you can optimise your crop protection strategy tailored to the nursery.



IPM is a step-by-step plan in which recording is central to achieving an optimal crop protection strategy.

Manual or electronic recording?
Select a system that suits you and that you can sustain.

"Do not record because you have to, but because it is useful for you."

Since incomplete or irregular recording is virtually the same as no recording, it is important that you select or design a recording system that suits you well and that you will maintain. This can range from records in a diary to a sophisticated database. If, for example, you do not use your computer on a daily basis, a written recording is probably the best option. Those who prefer to work with the computer can design their own database or use existing applications (e.g. VMS or MPS recording).

Useful information through recording

Like the recording system, the information you record can also vary from very simple to advanced. The absolute minimum is what is required by law. Below are some suggestions of additional things that are worth recording, provided you do something with them.

Scouting results or reason for treatment

Mentioning the pest you are treating for is a small addition: you can quickly write it as an abbreviation next to the product you are using or even design your recording form so that the most common pests are automatically included. In addition, you can note the stage of the pest and/or the severity of the infestation.

Recording scouting results has several advantages:

- You get a clear picture of which pests occur on the nursery (and in which period). Through records, you can compare different years and find out the possible causes of serious infestations.
- It is useful to clearly link your product choice to the pests you want to control. Especially when products disappear from the market, you may suddenly find yourself in a difficult situation and your crop protection plan has to be redesigned. At such times, it is very useful to know which product to use for each pest: Are there alternatives? Do you need to reserve certain products for specific pests?
- Recording of scouting results can help you to avoid resistance and - in combination with the recording of the treatment outcome - to detect it at an early stage. By stating for each product which pests it is used against, it is easy to check whether you are effectively alternating between products from different resistance groups to control them (7th IPM principle). Have you noticed that, year after year, a pest occurs more frequently and/or needs to be controlled at increasingly shorter intervals? Then be wary of resistance and seek professional advice.

Non-chemical crop protection

Also note the application of bioprotectants or the release of biological control agents. These records can remind you to take into account the interval after your previous chemical application (e.g. because the applied product is present on your crop for a long time and is harmful for the biological control agent) and the possible side effects of your next treatment. Moreover, non-chemical control is an additional approach in the fight against resistance and recording is necessary to keep an overview of the applied products (and corresponding resistance group).

Environmental parameters

Do you want to optimise and improve your pest control strategy? Then record the environmental parameters such as the climate during and immediately after application and the condition of the crop. A failed treatment or crop damage is sometimes very easy to explain with this additional information. Did the crop look poor or was there a very high light intensity just after treatment? Then this could be the explanation for crop damage. Did it start raining just after the outdoor treatment? Then chances are that your product was washed off before it could have an effect. Even though this information may not always seem useful at first, over time patterns may emerge that can help you optimise your control. Moreover, this information can be very useful for your advisor as he or she is rarely present at the time of treatment.

> "Your records are a treasure trove of information for customised professional advice."

Treatment outcome

Of course, it is also interesting to record the treatment outcome. Combined with information on scouting, environmental parameters and the treatment itself (product, dose, time, etc.), this allows you to optimise the crop protection plan: a failed treatment can be explained in many cases by an incorrect application. Can't find an explanation for treatment failure? Please contact your spokesperson or the PCS. The more information you can provide (through recording), the easier it will be for us to help you identify the cause of the failure and find a solution.

VIII

RECORD and evaluate:

· the reason for treatment

· the treatment method

AND LEARN

· optimise your treatment

IPM ORNAMENTALS CHECKLIST

(LEGISLATION SINCE 1 JANUARY 2014)

To check whether growers comply with the application of IPM legislation, a checklist was drawn up to quickly ascertain whether requirements are being met. Two checklists were drawn up to optimise uniformity between the different plant sectors: one for arable farming, fodder, vegetables and fruit growing, the other for ornamental horticulture.

The IPM Ornamentals Checklist is divided into four production systems: outdoor crops - soil-grown (BUG), protected crops - soil-grown (BIG), outdoor crops - soilless (BUN) and protected crops - soilless (BIN). Some crops combine two or more of these production systems, for example in Belgium tuberous begonia starts as a protected substrate-grown crop and then moves to an outdoor soil-grown crop.

Compliance with the general principles will be monitored by recognised, independent inspection bodies. The measures that receive a rating of 1 (= major) must be complied with. Those with rating 2 (= minor) must be complied with for a total of at least 70%. If 12 minor measures are applicable to your production system or systems (e.g. tree nursery with both field- and container-grown crops), you must definitely conform with 9 (= 75%). Finally, there are also many measures with a rating of 3, these are recommendations that can help you to apply IPM in an optimal way and thus achieve the best crop protection strategy for your nursery. If you have questions about the IPM Ornamental Checklist, you can contact ADLO.

LEGEND **1:** major: 100% compliant **2:** minor: 70% compliant **3:** recommendation **n/a =** not applicable		PROTECTED CROPS SOIL-GROWN (BIG)	PROTECTED CROPS SOILLESS (BIN)	OUTDOOR CROPS SOIL-GROWN (BUG)	OUTDOOR CROPS SOILLESS (BUN)
1. The prevention and/or elimination of pests must be achieved or facilitated by among other things					
1.1 Crop rotation (both within and outside the ornamental sector)					
1.1.1	Crop rotation (also within the same field) is an option for crops susceptible to soil-borne pests such as *Verticillium*, nematodes ... in cases where land use is not a limiting factor. With the exception of mother plants	N/a	N/a	**3**	N/a
1.2 Use of appropriate production methods (e.g. stale seedbed technique, sowing time and density, under-sowing, conservation tillage, pruning and direct sowing)					
1.2.1	Sow green manure crops against pests and diseases (e.g. *Tagetes*, Japanese oats ...)	N/a	N/a	**2**	N/a
1.2.2	Biodiversity and ecological aspects: minimum two measures from Appendix 1 (see table below)	N/a	N/a	**2**	**2**
1.2.3	Good soil water management (breaking up compacted layers, measures to promote or conserve structure, drainage, avoid compaction)	**3**	**2**	**3**	**2**
1.2.4	Reduce the use of plant protection products through adopted production methods, e.g. stale seed beds, row treatment, seed treatment	N/a	N/a	**3**	N/a
1.2.5	Take the necessary measures against erosion in fields prone to erosion	N/a	N/a	**3**	N/a
1.3 Use resistant/tolerant cultivars and standard/certified seed and plant material, where appropriate					
1.3.1	Use of resistant/tolerant species and cultivars if relevant to the crop/plants	**3**	**3**	**3**	**3**
1.3.2	Inspection by grower that the starting material or raw materials are pest and disease free, or that they are based on certified starting material	**3**	**3**	**3**	**3**

1.4 Use of appropriate fertiliser, liming and irrigation/drainage practices					
1.4.1	Optimal nutrition based on an adequate analysis of soil, substrate or irrigation water during preparation of a field and every three to five years thereafter. For substrate-grown crops, fertiliser application is adjusted according to the needs of the crop and the nutritional state of the substrate according to the supplier or an analysis. In case of a nutritional problem, an analysis of the substrate and/or irrigation water is performed	**2**	**2**	**2**	**2**
1.4.2	Targeted irrigation according to the plants' needs	**3**	**3**	**3**	**3**
1.4.3	Rainwater is preferably used for irrigation. Other water sources are: stream water, water from an open well, borehole water, tap water or water from approved sources	**1**	**1**	**1**	**1**
1.5 Prevent the spread of pests through hygiene measures (for example by regular cleaning of machinery and equipment)					
1.5.1	Treatment of the starting material before planting or propagation (saving the amount of active substance applied due to limited surface area)	**3**	**3**	**3**	**3**
1.5.2	Use clean pots, cutting and sowing trays	N/a	**1**	N/a	**1**
1.5.3	Store substrate and soil improvers under protection	**3**	**3**	**3**	**3**
1.5.4	Clean container beds and cultivation soils	N/a	**2**	N/a	**2**
1.5.5	Store (under cover) waste material containing crop and substrate residues or treat appropriately to avoid contamination by pests and diseases	**1**	**1**	**1**	**1**
1.5.6	Regularly remove diseased plants and plant remains	**2**	**2**	**2**	**2**
1.5.7	In high risk situations: clean and/or disinfect tools and machinery regularly (at least between two soil or crop batches)	**3**	**3**	**3**	**3**
1.5.8	In case of quarantine organisms, follow the relevant regulations	**1**	**1**	**1**	**1**
1.5.9	For high-risk nurseries (easily transmissible pests): use of footwear disinfection facilities for internal movement and visitor overalls for external movement	**1**	**1**	N/a	N/a
1.5.10	Respect the order in which crops are treated: from healthy to high risk crops	**3**	**3**	**3**	**3**
1.5.11	Optimal air movement control in the crop (venting, heating)	**3**	**3**	N/a	N/a
1.5.12	Disinfection of drain water in case of reuse	N/a	**3**	N/a	**3**
1.6 Protection and promotion of important beneficial organisms, for example by appropriate management measures or the use of ecological infrastructure within and outside production areas					
1.6.1	Promote natural enemies under protection by for example: banker plants, hiding and breeding places, ventilation	**2**	**2**	N/a	N/a
2. Pests must be monitored with appropriate methods and tools, where available. These tools include, where possible, monitoring and scientifically sound warning, forecasting and early diagnosis systems, as well as taking into account advice from qualified professional advisors					
2.0.1	Crop scouting by among other things visual observations, use of sticky traps, pheromone traps, etc. indicator plants ... and lists of most important diseases	**1**	**1**	**1**	**1**
2.0.2	Acquire knowledge on recognising parasites, predators and beneficial insects by: 1) being a member of a recognised Monitoring and Warning System or Advisory Service or Decision Model or 2) following IPM education activities (min. 1/year) or 3) being advised by a qualified professional advisor	**1**	**1**	**1**	**1**
3. Based on the results of the monitoring, the professional user must decide whether and when to take management measures. Strict and scientifically based threshold values are essential components in the decision-making process. Where possible, thresholds established for the region, specific areas, crops and particular climatic conditions should be taken into account before the treatment of pests					
3.0.1	Use of available decision-making systems for crop protection (demonstrating that positive action has been undertaken action): e.g. damage threshold, temperature sum, advisor, own experience, etc.	**1**	**1**	**1**	**1**
4. Sustainable biological, physical and other non-chemical methods should be preferred to chemical methods if they provide satisfactory pest control					
4.1 Possible additions or alternatives to chemical weed control, depending on the crop and circumstances, such as					
4.1.1	Alternative weed control where possible (e.g. cover crops, organic mulches, organic cover materials, mechanical and thermal weed control ...)	**3**	**3**	**3**	**3**
4.2 Possible additions or alternatives to chemical pest and disease control, depending on the crop and circumstances such as					
4.2.1	Use of recognised biological and natural products against diseases and pests	**3**	**3**	**3**	**3**
4.2.2	Use or promotion of natural enemies (e.g. predatory mites, parasitic wasps, nematodes against (vine) weevil larvae, ladybirds, etc.)	**2**	**2**	**3**	**3**
4.2.3	Use of physical methods (e.g. trapping and roller traps, slow sand filter to trap fungi, heat treatment of young planting material, UV treatment, ozone treatment, insect netting, etc.)	**3**	**3**	**3**	**3**

4.2.4	Soil sterilisation if necessary, preferably non-chemical	**3**	N/a	**3**	N/a
5. The plant protection products used should be as targeted as much as possible and have the least side effects on human health, non-target organisms and the environment					
5.0.1	Management of stock control of plant protection products. Stock management = recording of movement in and out, separate storage of products that are no longer usable, orderly arrangement of products by type (insecticides, fungicides ...) and adequate storage of the empty packaging	**1**	**1**	**1**	**1**
5.0.2	Select plant protection products based on their side effects, using available data (selectivity lists ...)	**3**	**3**	**3**	**3**
5.0.3	Select plant protection products based on their efficacy in relation to the stage of the disease, pest or weed	**3**	**3**	**3**	**3**
5.0.4	Use an approved spray application device in accordance with legislation	**1**	**1**	**1**	**1**
5.0.5	Calculate the amount of plant protection product needed to avoid waste	**2**	**2**	**2**	**2**
5.0.6	Take measures to avoid point source pollution of surface waters	**2**	**2**	**2**	**2**
5.0.7	Clean and store empty plant protection product packages (incl. seals)	**1**	**1**	**1**	**1**
5.0.8	Use drift-reducing nozzles, where possible	N/a	N/a	**2**	**2**
5.0.9	Respect a no-spray buffer zone with surface water of 1 m (excl. 3 m for orchard sprayer)	N/a	N/a	**1**	**1**
5.0.10	Dilute waste spray solution and apply it over the crop	**2**	**2**	**2**	**2**
6. Professional users should limit the use of plant protection products and other treatments to the level necessary, for example through reduced application frequencies or spot treatment, ensuring the risk to the crops is acceptable and that by doing so it doesn't increase the risk of resistance in the pest populations					
6.0.1	Use of appropriate and effective spray application methods	**2**	**2**	**2**	**2**
6.0.2	Local targeted application with approved dose (e.g. foliar herbicides, seed coating treatment ...)	**3**	**3**	**3**	**3**
6.0.3	Evaluate climatic conditions in relation to the plant protection product for maximum efficiency	**3**	**3**	**3**	**3**
7. When the risk of resistance to a control measure is known and where the pest level is such that multiple applications of plant protection products to the crops is necessary, the available anti-resistance strategies should be implemented to maintain the effectiveness of the products. This may involve the use of various products with different modes of action					
7.0.1	Alternating and/or tank mixing products with different modes of action	**2**	**2**	**2**	**2**
8. Based on the plant protection product application records and pest monitoring, the professional user must assess the success of the applied control measures					
8.0.1	Record use of plant protection products in accordance with the requirements of the FAVV: name of product, crop, location, dose. Records kept for three years	**1**	**1**	**1**	**1**
8.0.2	Record on the monitoring form the level of control generated	**3**	**3**	**3**	**3**
8.0.3	Record non-chemical crop protection	**3**	**3**	**3**	**3**
8.0.4	Record the result of the treatment	**3**	**3**	**3**	**3**

Appendix 1: At least two of these measures to promote beneficial organisms, biodiversity and ecological aspects must be applied on the nursery

- Appropriate placement and/or maintenance of nest boxes and/or perches for birds (tits, birds of prey, etc.).
- Appropriate placement of artificial shelters and nesting places for wild solitary bees (*Osmia*, *Andrena*, etc.) and/or for overwintering beneficial insects (lacewings, ladybirds, etc.).
- Provide and/or maintain natural shelter and nesting places for overwintering beneficial organisms (hedges, bushes, trees, reed beds, etc.).
- Plant and/or maintain mixed hedges (blackthorn, elderberry, ivy, willow, spruce, etc.) around the crop/field as a refuge for beneficial insects.
- Create or maintain a flower strip or wild vegetation strip with a width of at least 1 m.
- Maintain a compensatory ecological area covering at least 2% of the nursery. This area shall not receive any fertiliser or plant protection products.
- Keep uncultivated strips completely free of weeds by mechanical means.
- Sow or plant ground cover plants or green crops.
- Meadow bird management through protection of bird nests and/or construction of refuge strips.
- Field bird management such as planting mixed grass strips, lark patches, woodland edges, winter stubble or cereal edges.
- Create grass buffer strips.
- Encourage natural enemies under protection by e.g. banker plants, leaving non-diseased plucked leaves, ventilation.

Source: 'Praktijkgids gewasbescherming: katern IPM Sierteelt, (Practical guide to crop protection: IPM in ornamental crops) F. Goossens en P. Braekman, ADLO, 2014'

USEFUL ADDRESSES

PCS

Ornamental Plant Research (Proefcentrum voor Sierteelt)
E: info@pcsierteelt.be – T: 09 353 94 94
Trees and foliage – E: filip.rys@pcsierteelt.be
Azalea and rhododendron – E: els.pauwels@pcsierteelt.be
Indoor plants and tuberous begonia - E: marc.vissers@pcsierteelt.be
Cut flowers, bedding plants and pot chrysanthemums -
E: liesbet.blindeman@pcsierteelt.be
Warning System - E: waarschuwingen@pcsierteelt.be
Crop Protection Consultancy Service - E: marc.vissers@pcsierteelt.be

On the PCS website, you will find a lot of information about our research in ornamental crops and our services, such as the Monitoring and Warning System for nurseries, landscaping and parks, the Crop Protection Advisory Service and Phytotoxweb. Moreover, you can also visit the site where all our information and demo activities are promoted.

www.pcsierteelt.be

ADLO

Flemish Government, Department of Agriculture and Fisheries,
Sustainable Agricultural Development Division
E: frans.goossens@lv.vlaanderen.be – T: 09 272 23 15
E: pascal.braekman@lv.vlaanderen.be – T: 09 272 23 09

You can find a lot of useful information on the ADLO website, such as 'Praktijkgids Gewasbescherming' (Practical guide to crop protection) and 'Praktijkgids gewasbescherming: katern IPM Sierteelt' (Practical guide to crop protection: IPM in ornamental crops). If you have any questions about regulations, please contact the policy advisors.

www.vlaanderen.be/landbouw

ILVO

Flanders Research Institute for Agriculture, Fisheries and Food
E: ilvo@ilvo.vlaanderen.be – T: 09 272 25 00

In addition to research, ILVO also provides a number of other useful services. The Diagnostic Centre for Plants identifies unusual pests. On the website of the Dienst Keuring Spuitstellen (Spray Equipment Inspection Service) you will find information about compulsory inspections and you can download forms and make declarations.

www.ilvo.vlaanderen.be/diagnosecentrum
www.ilvo.vlaanderen.be/keuringspuittoestellen

Phytoweb

Access to the database of authorised plant protection products and their approvals. They can help facilitate the choice from the range of authorised products in Belgium. You will also find additional information on the products.

www.fytoweb.be

Phytolicence

This is where you can apply for the pesticide licence: the certificate from the federal government that proves that, as a professional user, you can handle plant protection products and additives correctly.

www.fytolicentie.be

Flemish Ornamental Horticulture Environmental Plan

The VMS is a centre for sustainable business where ornamental crop nurseries are guided via a step-by-step plan towards future-oriented, socially responsible business operations, including by means of MPS certification.

www.vms-vzw.com

Phytofar

Phytofar is the Belgian Crop Protection Industry Association. Phytofar promotes the proper use of plant protection products to ensure sustainable agriculture that respects humans, animals and the environment.

www.phytofar.be

PhytofarRecover

PhytofarRecover coordinates the collection of empty packaging of plant protection products and non-useable plant protection products from the professional sector.

www.phytofarrecover.eu

Sierteelt & Groenvoorziening (Floriculture & Landscaping) (AVBS)

This guide is a compilation of articles by PCS and ADLO about the 8 principles of IPM, published in Sierteelt & Groenvoorziening (Floriculture & Landscaping). In the future you can also find current information about integrated pest management in the trade journal of AVBS (the floriculture & green federation).

www.avbs.be

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Changes to the IPM checklist - 1 April 2017

On 1 April 2017, the Department of Agriculture and Fisheries communicated the following changes to the IPM checklist:

	BIG	BIN	BUG	BUN
1.5 Prevention of the spreading of pests by hygiene measures (for example by regular cleaning of machinery and equipment)				
1.5.13 Measures to prevent the spread of yellow nut sedge *(Cyperus esculentus):* infected fields...: • cultivate last • AND clean machinery on leaving the field • AND apply mechanical or chemical control • AND prohibit the cultivation of root, tuber and bulb vegetables unless practically all soil is removed by washing, brushing, sorting, sifting, etc • AND prohibit any soil removal, except for soil in root-balled plants after inspection • in the case of rented land, an agreement is made between the landlord and the tenant whereby the landlord declares the land concerned to be free of yellow nut sedge	1	N/a	1	N/a
5. The pesticides used should be targeted as much as possible and have the least side effects on human health, non-target organisms and the environment				
5.0.8 Use drift reducing nozzles of at least 50% drift reduction	N/a	N/a	1	1
5.0.6 Take measures to avoid point source pollution of surface water	2	2	2	2