Guidance Notes

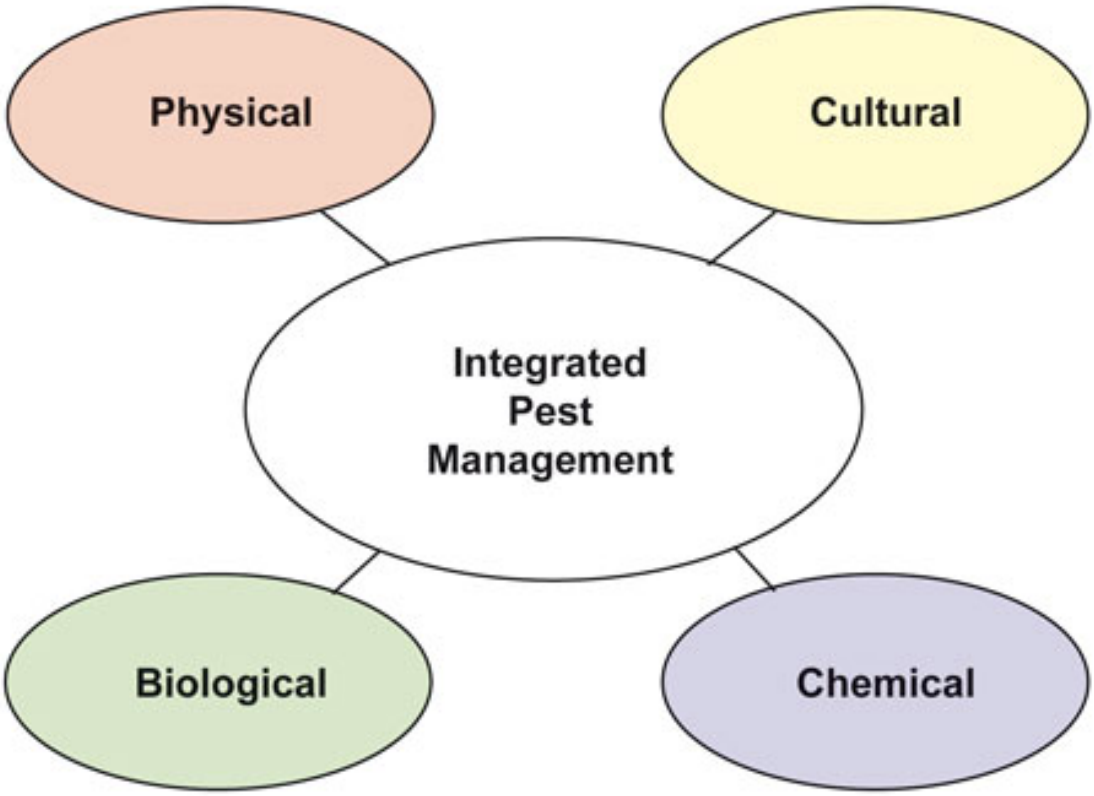
on

Integrated Pest Management

For Use On

Irish Farms

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara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Frequently Asked Questions

What is Integrated Pest Management (IPM)?

As defined in the sustainable use of pesticides directive (Directive 2009/128/EC), 'integrated pest management' means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms;

In more simple terms:
"IPM is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks."
(North Dakota State University)

Who should use IPM?

All professional users of Plant Protection Products (PPPs) must operate to the "general principles" of IPM from **January 1st 2014**. Professional users of PPPs are encouraged to adopt crop specific or sector specific guidelines for the production of certain products.

What is a professional user of PPPs?

As defined in the sustainable use of pesticides directive (Directive 2009/128/EC),, a 'professional user' means any person who uses pesticides in the course of their professional activities, including operators, technicians, employers and self-employed people, both in the farming and other sectors;
So, in effect all users of PPPs, except those who merely use PPPs in an amateur context such as private garden use.

What are the general principles of IPM?

The general principles of IPM are a set of guiding bases which were defined in the sustainable use of pesticides directive. They are designed to help end users of PPPs to reduce reliance on PPP use and to reduce the risks associated with such use. They are easy to understand and easy to implement.

What IPM records will farmers/growers be required to maintain?

Records proving implementation of IPM must be maintained by all farmers/growers. If using a PPP the reason for using the PPP should be recorded in the user's Pesticide Application Record sheet (see Appendices). A "tick box" worksheet has also been designed to enable farmers/growers demonstrate how they are adopting the general principles of IPM (see Appendices).There are no exemptions from the requirement to maintain these records.

What happens if I do not maintain records?

The marketing and use of PPPs is primarily covered by the approval regulation (Regulation (EC) No 1107/2009) and the sustainable use of pesticides directive (Directive 2009/128/EC). Both pieces of legislation are covered under Statutory Management Requirement 9 (SMR9), therefore if records are not provided to prove implementation of the general principle of IPM, a percentage disallowance of an individual's Single Payment will ensue, with a possibility of prosecution. In situations where the professional end user/grower/farmer is not a recipient of Single Payment, DAFM may issue fixed penalty notices or seek to prosecute them through the legal system.

General principles of integrated pest management *(excerpt from Annex I to Directive 2009/128/EC)*

1. The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

— crop rotation,

— use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing),

— use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material,

— use of balanced fertilisation, liming and irrigation/drainage practices,

— preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment),

— protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.

2. Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.

3. Based on the results of the monitoring the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.

4. Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.

5. The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.

6. The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.

7. Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.

8. Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.

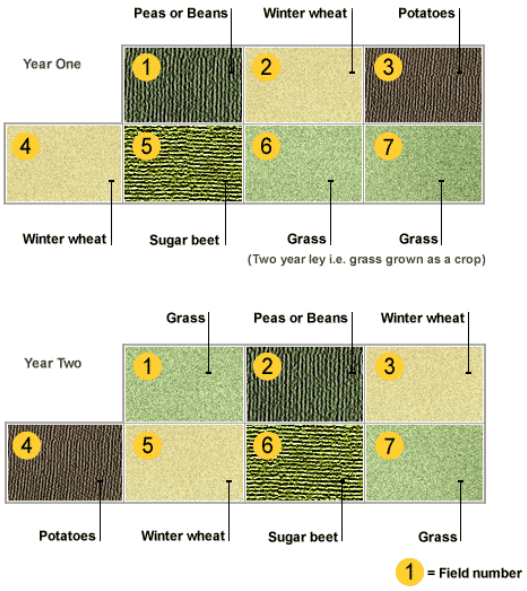
IPM Record Sheet

When completing the IPM record sheet, the end user should tick the options that are most appropriate to their holding. The IPM record sheet is not exhaustive and allows the end user to add other options.

Background and brief description

1. The prevention and/or suppression of harmful organisms			
Crop rotation	☐	Sterile seedbed technique	☐
Clean machinery and equipment	☐	Clean potato boxes/growing trays etc..	☐
Nutrient management programme	☐	Irrigation (applied to schedule)	☐
Soil testing (pH, nutrients, OM)	☐	Protect beneficial organisms	☐
Certified seed	☐	Full inversion tillage (plough)	☐
Choose disease resistant varieties	☐	Minimum cultivation	☐
Management of crop residues	☐	Soil structure & compaction	☐
Use of optimal sowing date	☐	Clean crop storage areas	☐
Other (please specify)			

Sterile seed bed technique
The sterile seed bed technique involves cultivating the soil, and then leaving it for a period until an initial flush of weeds has germinated. The grower will then either lightly cultivate or use a total herbicide to destroy the weed cover, before the desired crop is planted/sown.



Crop Rotation
Crop rotation involves the successive planting of different crops on the same land to improve soil fertility and help control troublesome insects, diseases and weeds.
Whilst the continuous cropping of some crops can be successfully done without any major agronomic disadvantages e.g., spring barley, It is generally good practice to follow some degree of crop rotation. Continuous cropping of certain crops can result in higher input costs, lower yields, higher pest pressure and increased likelihood of resistance. For example, 2 or 3 successive crops of winter wheat will yield significantly lower than growing a winter wheat crop after a broadleaved break crop, due largely to effects of the "take all" fungus (*Gaeumannomyces graminis*).

Cleaning Machinery and equipment

Machinery can often be responsible for the transport of pests from field to field or farm to farm. Examples of this are situations like potato cyst nematode or beet cyst nematode being carried from one field to another on soil particles on machinery. Another example is where a combine harvester/baler transports wild oat seeds from one location to another.

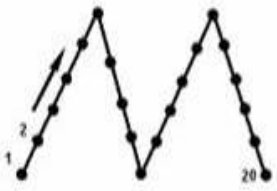
Clean potato boxes/growing trays etc..

Good growing and storage hygiene is important to minimise the spread of many pathogens injurious to many crops. Pathogens such as "black leg" (*Erwinia spp.*) in potatoes, can be transmitted by debris etc.. on boxes. Steam cleaning can eliminate such possibilities. Similarly, cleaning and/or disinfecting growing trays, remains a useful way to reduce the initial source of inoculum. The same principle holds true for storage boxes and trays for all types of crop.

Irrigation (applied to schedule)

Irrigation scheduling determines the correct frequency and duration of watering of the crop concerned. The goal in irrigation scheduling is to apply enough water to fully wet the plant's root zone but avoiding over watering. The soil is then allowed to dry out to allow air to enter the soil and encourage root development. Schedules can be constructed by using simple water balance sheets which consider how much water the crop utilises per day, how much rainfall occurs, the level of moisture in the soil etc.. Such schedules can be augmented by data from tensiometers, or more elaborate electron probe measuring devices.

Efficient use of water can not only improve yield and quality, e.g., potatoes free of common scab (caused by *Streptomyces scabiei*), it can improve the overall crop health ensuring that the crop is less susceptible to a range of other crop pests



Soil testing (pH, nutrients, OM)

Soil analysis allows you to match fertiliser application to crop requirement ensuring optimum crop production. It also has the added benefits of reducing nutrient loss to the environment and growing farm profitability. Both macronutrient and micronutrient availability are affected by soil pH. In alkaline soils, N, K, Mg and Mo availability is increased, but P, Fe, Mn, Zn Cu, and Co levels are reduced.

Nutrient management programme

A nutrient management programme or plan is where the application of fertiliser/manure (artificial or by-product) is tailored to the specific requirements of the crop being treated and the target soil fertility index. This approach has many benefits in that the end user only applies as much fertiliser as will be utilised by the crop, thereby eliminating excess which could be subject to run-off and a cause of pollution. By applying as much fertiliser as will be utilised by the crop, when the crop needs it, you are ensuring that the crop is kept in optimum nutritional condition which can reduce its susceptibility to pests. This approach also has benefits from a financial perspective. However, in many situations the peak nutrient usage of the crop may exceed the actual amount of nutrition applied, therefore the availability of nutrient reserves becomes an important component of a well balanced and productive soil. However, application of N and P should not exceed those prescribed in the nitrates regulations (SI 610 of 2010 & the "Teagasc Green Book")

Protect beneficial organisms

In agriculture, a beneficial organism is any organism that benefits the growing process, including insects, arachnids, other animals, plants, bacteria, fungi, viruses, and nematodes. Benefits include pest control, pollination, and maintenance of soil health. Encouraging beneficial insects, by providing suitable living conditions, is a pest control strategy in itself. Depending on the beneficial organism targeted for protection, the method can vary from unsprayed areas of farms to cultivation of specialist areas with wild flowers or small seed plants. Research work conducted by Teagasc in Oakpark indicates that the use of minimum cultivation techniques can reduce aphid pressure on the established crop when compared to crops established with the more conventional approach (plough, till and sow).

Full inversion tillage (plough)

This is usually an operation carried out using mouldboard ploughs. It essentially involves the turning of a depth of soil (usually 20-40cm) upside down. This results in the burial of what is termed "trash", which can comprise of crop debris which may harbour plant pests and other unwanted plant material such as diseases and weeds. E.g. the DAFM published "Code of Practice on the prevention and reduction of Fusarium Mycotoxins in cereals" recommends ploughing as part of a mycotoxin reduction/prevention strategy.

Minimum cultivation

Minimum cultivation is sometimes referred to as “min till” and involves very shallow cultivation in as few a number of passes possible. It works on a principle which involves minimum disruption to the soil structure and is the opposite of inversion tillage. The main benefit from this practice is the improvement of soil structure which generally involves an increase in earthworm numbers but other advantages include lower aphid pressure and increased work rates. The full benefits of this practice are not seen for several years after embracing this option. Depressed yields are often experienced for the first few years. It should be noted that this practice can give rise to increased levels of grass weeds which can be problematic to control e.g. sterile brome and blackgrass. Increased slug activity can be a feature of this method of crop establishment. This system tends to work best for autumn based cropping but can give rise to establishment issues in very wet autumns.

Management of crop residues

Crop residues are parts of the crop remaining after the crop has been harvested. These residues can include the root system, stubble (stems), stalks, leaves, straw and actual seed. Various cultivation techniques can be used to initiate or enhance microbial decomposition of crop residues. Management of these crop residues can have a positive effect on soil organic matter and decreases the likelyhood of soil erosion.

Shallow cultivation using tine or disc based machines or consolidation using rolls and presses, permits weed seed and previous crop seeds to germinate which can then be controlled chemically prior to drilling. Ploughing helps to bury weed seeds and plant debris thereby breaking the weed/disease cycle.

Soil structure & compaction

Soil structure can be considered as merely the arrangement of the particles in the soil. It is characterised by the way in which individual soil colloids amalgamate or aggregate together. The way in which this happens also impacts the number and size of soil pores. The size and extent of these pores controls the way in which air and water move through the soil profile. Soil structure also has an impact on biological activity and processes, root development and seed germination and emergence. Soil structure can change over time.

Soil compaction is what results when a stress is applied to a soil, causing the soil to become more dense. This increase in density displaces air and decreases pore space between soil particles. Soil compaction is usually caused by excessively heavy traffic on the soil. This heavy traffic can take the form of either machinery and equipment or animal traffic. Soil compaction is best avoided as it can take many years to successfully remove it from an area. Where compaction is an issue, it can be fixed with the help of certain machines with deep action legs. Modifying cropping pattern can help this process also.

Certified Seed

Certified seed is seed that was produced within an officially recognised seed certification system. The resulting certification, certifies that a seed lot, packet or box of seed contains seed produced, inspected and graded, is in accordance with the requirements of a Certification Scheme. Such requirements include minimum levels of varietal purity and tolerance levels of weed seeds. Minimum levels of seed germination and vigour are also guaranteed.

Choose disease resistant varieties

Host plant resistance relates to a plant's ability to resist pest damage. Some plants use their physical appearance as a deterrent such as plants that have hair covering their leaves or plants with a thick leaf cuticle. Some plants have resistance genes bred into them which enable them to fight infection or infestation. Therefore, considering a plants inherent ability to cope with stress or damage caused by a plant pest is important. Whilst a resistant variety can reduce dependence on the use of PPPs, one must also consider quality and yield parameters together with market and legislative requirements. For some diseases there are legal limits established, e.g., fusarium mycotoxins deoxynivalenol (DON) and zearalenone (ZON) in wheat intended for human consumption. There are also guidance limits established for feed grain. Trial research by both DAFM and Teagasc, Oak Park, show significant differences in between cultivars in their inherent resistance to diseases.

Use of optimal sowing date

Date of sowing can influence disease development and the level and extent of insect infestation. Under favourable conditions early sowing of winter cereals can lead to significant yield increase in the absence of severe pest competition. However, in general, earlier sowing of winter cereals leads to higher incidence of disease and earlier infestation with aphids but generally lower slug related problems. It is good practice to have a mix of sowing dates and to aim to match sowing date with cultivar and rotation, e.g., sowing 2nd wheat as late as possible to reduce effects of "take-all" and reduce reliance on seed dressings active against "take-all"

In autumn/winter, sowing date dramatically influences seeding rates. Seeding rates increase as temperatures decrease and soils become wetter.

Clean crop storage areas

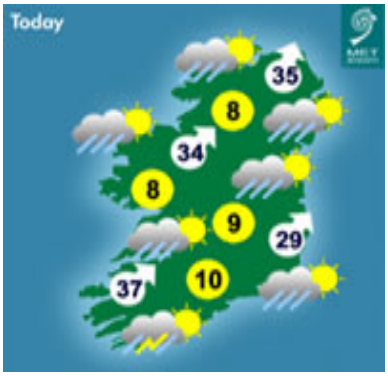
Crop pests (both insects and pathogens) can often be a problem in store. Therefore it is good practice and advisable to ensure that all surfaces that the crops will come in contact with are clean and free of debris from previous crop and indeed free of any pests. All air ducting and the main plenum should also be thoroughly cleaned to ensure no unwanted carry over. Cleaning can involve high powered vacuum cleaners as well as steam cleaning and also the application of insecticides or fungicides.

2. Monitoring of harmful organisms			
Use early warning/forecasting systems		Monitor crops for pests/diseases	
Use weather forecast to aid decisions		Advisor monitors crops	
Can identify main pests		Use traps/sticky pads/lures	
Other (please specify)			

Use early warning/forecasting systems
Delaying intervention until treatment is absolutely necessary is feasible in some crop production contexts. A range of disease forecasting systems are available and can be quite useful to supplement observations made during site visits.

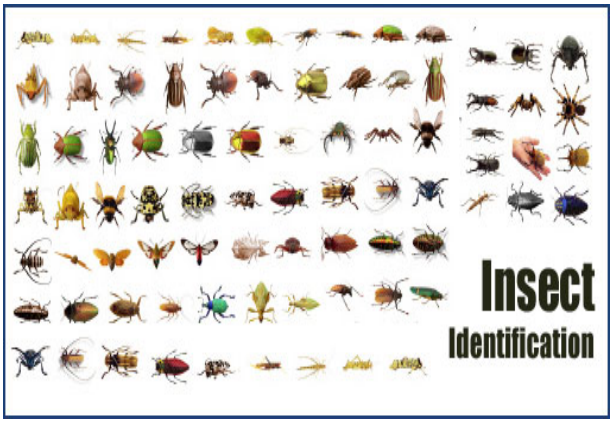
Monitor crops for pests/diseases
This remains the most useful and widely practiced option. Crops are treated on the basis of the presence or not of pests or whether threshold levels have been breached. However, sometimes crops require prophylactic treatment and so if one were to wait for certain diseases to appear it would be too late, e.g., late blight (*Phytophthora infestans*) in potato, downy mildew (*Peronospora viciae*) in field beans or leaf blotch (*Septoria caused by Mycosphaerella graminicola*) in wheat. Field monitoring should consider uneven distribution of crop pests and the presence of certain physical characteristics such as compacted headlands, sheltered areas and wet spots etc..

Use weather forecast to aid decisions
Weather has a major influence on the development of diseases and the prevalence of insect pests. Weather also plays a part on how effective intervention strategies are, e.g., likelihood of rain around the time of PPP application. The short to medium term weather forecast can and does influence the rates of application of PPP and the effectiveness of applied treatments. It could also influence PPP choice or indeed use of other control mechanisms

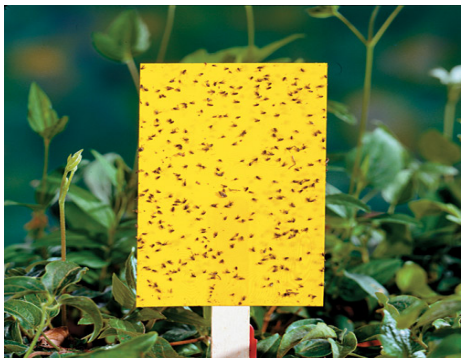


Advisor monitors crops
While an individual farmer/grower can be very proficient in identification of weeds, insects and diseases, an advisor can bring another dimension to monitoring crops. The advisor is usually monitoring crops in different locations, on different varieties, under different growing conditions etc.. and this facilitates a potentially more informed view. This view can be particularly useful in predicting what way an individual disease or insect pest may develop.

Can identify main pests
The ability of individual farmers/growers to identify at an early stage, the main, most important weeds, diseases and insects is extremely beneficial. Early identification often acts as a key driver for intervention method or product choice. It also can influence the timing of application, but it can also allow for better and more efficient use of advisors. Pest occurrence can influence choice of next crop. There are several online tools and apps which are useful in the identification of plant pests and diseases.

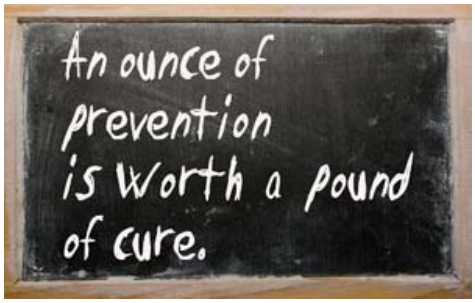


Use traps/sticky pads / lures
The use of various trapping techniques can serve to prove presence or not of an insect pest (to a lesser extent fungal spores). Ability to positively identify the insect pest is then required. Practical examples of trapping include, carrot fly (*Psila rosae*) traps and “layers mash” lure for slugs (molluscs)



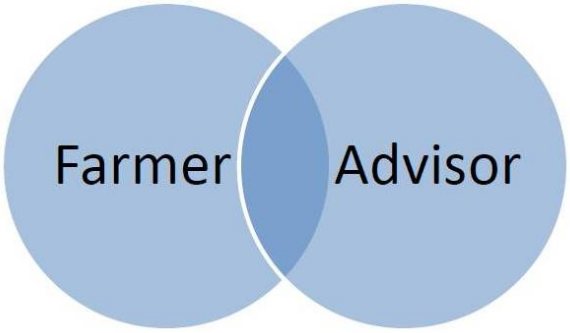
3. Application of plant protection measures			
Some crops treated preventatively		Advisor makes decision	
Decisions jointly made with advisor		Some decisions based on pest thresholds	
Other(please specify)			

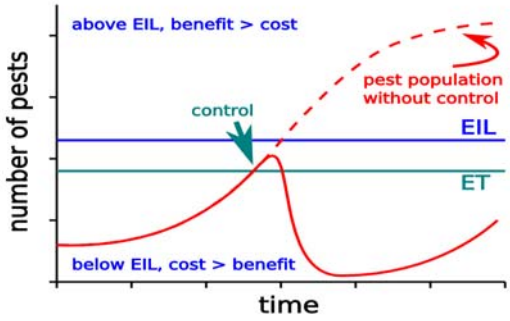
Some crops treated preventatively
Preventative treatments may be the best option to control a pest & can mean a lesser ppp loading than is required in a curative/eradicant situation.



Advisor makes decision
When an advisor is the only person involved in the decision making process the grower is effectively devolving their responsibility to the advisor. This can be for several reasons including, the size and extent of the farmed area, the skill set of the grower, skill set of the advisor and the level of service offered by the advisor.

Decisions jointly made with advisor
Decisions made jointly (advisor and grower) can benefit in a multi-dimensional way. The grower and the advisor often have different perspectives on the overall production of the crop. These different perspectives consider all aspects including, historic infestation and treatment, results of historic treatments, economic considerations, environmental issues, climatic conditions and cultivar etc…





Some decisions based on pest thresholds
Some crops have well developed treatment thresholds for pests. Some of these thresholds are based on effects deleterious to yield while others are based on effects deleterious to crop quality. Other crops do not have well developed pest injury thresholds yet but work on thresholds is on going around the world.
e.g., pollen beetle control in oilseed rape judged necessary if 3-5 beetles are present per raceem.

4. Sustainable biological, physical or other non-chemical methods			
Use natural enemies		Use crop fleeces	
Use micro-organism plant protection products		Use crop netting	
Use propane burners for weed control		Use mechanical weeder (e.g., steerage hoe)	
Use manual methods		Use deterrents (bangers, kites etc..)	
Use of topper/mower for weed control			
Other (please specify)			

Use natural enemies

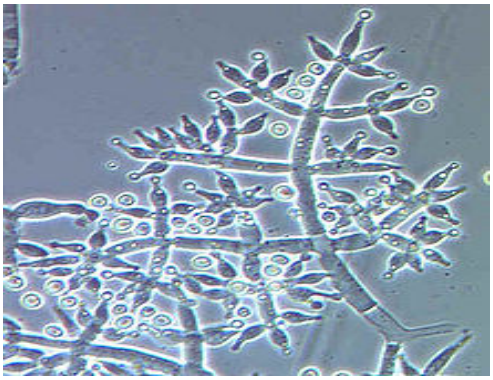
Natural enemies are organisms that kill or otherwise reduce the numbers of another organism. Natural enemies that limit pests are key components of many integrated pest management programs, particularly in protected crops. The most important natural enemies of insect and mite pests include predators, parasites, and pathogens. Examples of these are lady birds which prey on many aphid species and parasitic wasps which prey on whitefly.

Use crop fleeces

Crop fleeces can be multifunctional. They can protect crops from frost and cold conditions. They can serve to warm up the soil and vegetation thus encouraging and enhancing growth. Finally, depending on the type used, they can prevent the entry of certain insect pests. However, in some situations the use of a fleece can serve to create a micro climate of its own, which in turn can present issues regarding the proliferation of pests under the fleece or the occurrence of diseases often more virulent than in open air. Another issue around the use of fleeces, particularly for longer more protracted periods, is the ability of the grower to intervene with crop protection measures if necessary.

Use micro-organism plant protection products

Plant protection products (PPP) can be made up of synthetically or naturally occurring chemicals. However, naturally occurring micro-organisms can be included in PPP formulations. These micro organisms can have a direct effect on the target pest or they can act as a competitor to the existing pest. The general perception is that such products are safer because they are "naturally occurring", however, each individual product can vary significantly in classification, as with chemical based PPPs.



Use crop netting

Nets are used on some high value crops to prevent entry of insect pests, provide shading or to prevent damage from hail. In some countries entire areas are covered e.g. cherry plantations to protect from bird damage. Some vegetable growers employ very fine netting to cover swedes to protect from cabbage root fly. However, as with the use of mulches or crop fleeces, the use of very fine netting (<1.5mm) can result in the proliferation of other problems such as crop diseases.

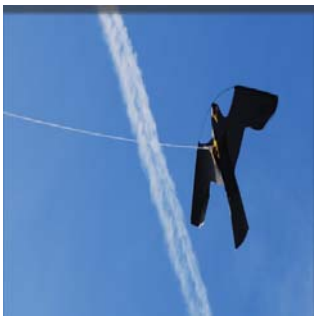
Use propane burners for weed control

Gas fired burners (either propane or butane) are sometimes used in weed control programmes for row crops. Some of these burners are handheld and hand operated while others are tractor mounted, depending on the application / scenario. It should be noted that this method may present a higher carbon footprint than many other methods. It should also be noted that propane burning is deleterious to organic matter levels in the upper profiles of the soil. Longevity of control is also an issue.

Use mechanical weeder (e.g., steerage hoe)

Mechanical weed control can be achieved by the use of steerage hoes or light "pig tail type" harrows. Such techniques can achieve moderate levels of weed control in some crops. It should be noted that multiple passes are usually required. Longevity of control is an issue particularly in wet climates.

Use manual methods
Manual weeding is often used in conjunction with mechanical methods for weed control. However, this is generally reserved for very high value crops as it is extremely expensive and longevity of control is an issue.

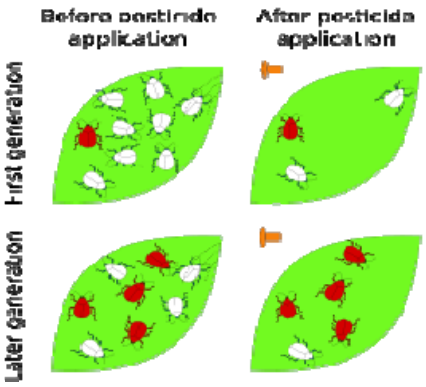


Use deterrents (bangers, kites etc..)
Primarily used to deter birds from crops, bangers, kites and other optical and sound generating devices are in general an environmentally sensitive means of protecting crops from bird damage. However, birds can become accustomed to such devices and so use of such devices requires a change from one method to the other within a certain time period.

Use of topper/mower for weed control
This is a method used in orchards/vineyards etc., where there is usually a grassed area between each row of trees/vines etc.. This method can be used in grassland against some weed species.

5. The pesticides applied shall be as specific as possible for the target pest.			
Applications usually for multiple pests		Resistance development is considered	
Different modes of action considered		Broad spectrum products avoided	
Different products considered		Familiar with different product labels	
Economics are considered		Use advisor to help decide on product(s)	
Consider following crops		Buffer zones are considered	
Use weed licker for weed control		Use of seed dressings	
Avoid insecticide use where bees are foraging		Use drift reducing nozzles	
Use air assisted sprayer		Other drift reducing methods	
Other (please specify)			

Applications usually for multiple pests
It is best practice to choose plant protection products or tank mixes of different products which are efficacious against plant pests of significance which have occurred or are likely to occur. It is not considered good practice to routinely include additional products for the control of infrequent or less damaging pests. It is frequently the case that a product is effective against more than one disease e.g., cereal fungicides are often effective against both Leaf blotch (caused by *Rhynchosporium secalis*) and Net Blotch (caused by *Pyrenophora teres*).



Resistance development is considered
Development of resistance is always a threat where the same product or same product type are being used time after time. This is especially an issue where the typical growing season gives rise to multiple generations of a pest species. Also, where plant diseases are capable of both sexual and asexual reproduction, rapid development, and hybridisation is possible giving rise to different biotypes.
There are several examples of resistance development including poppy and chickweed resistance to sulphonyl urea herbicides.

Broad spectrum products avoided
In general when using a PPP, each active substance contained in that product should be considered absolutely necessary. Therefore, use of products containing multiple active substances and products which contain both insecticides and fungicides should be scrutinised before use.

Different modes of action considered

In considering the likelihood or possible development of resistance, it is good practice to use a combination of chemical, cultural and biological control measures. Where chemical control is chosen, it is important to select products with alternative modes of action to avoid the potential selection of resistant individuals/isolates. Examples of such strategies are using chlorothalonil based products in conjunction with triazole based products or using sulphonyl urea based products with phenoxy acid based products.

Different products considered

Consider the use of products that do not impact negatively on a range of beneficial organisms. Alternate the types of chemistry used to ensure that target organisms do not build a tolerance to the product and to prevent the same non target organism from being impacted time and time again.

Familiar with different product labels

Farmers/growers and advisors should be familiar with an array of different product labels and they should be acquainted with details of how and when products should be applied as well as any precautions that are required around safe application of the product. Particular attention should be paid to operator exposure, no spray buffer zones etc..

Economics are considered

Crops are cultivated as a source of food for humans, or feed for animals. However, the farmer/growers that produce these crops do so as a livelihood. Therefore, economics must always be a consideration when choosing a crop protection solution. Economics are also a consideration when choosing individual PPPs.

Use advisor to help decide on product(s)
Depending on the level of experience and extent of their production, farmers/growers can benefit to varying degrees from consulting with advisors. Advisors will tend to have a wider experience.

Consider following crops
Crop protection measures must be considered in the context of the overall production system, e.g., if a cereal crop is slow to mature and you need to establish oilseed rape in the field, the application of a desiccant to the crop can be justified.

Buffer zones are considered
It is frequently the case that when PPPs are being approved, a no spray buffer zone is indicated as being compulsory. These buffer zones are usually associated with adjacent aquatic areas but sometimes a buffer zone to protect non target arthropods in field margins is also prescribed. Where this is the case, the prescribed buffer zones should be respected.

Use weed licker for weed control
Where tall weeds are of concern in a low crop e.g., nettles, thistles and rushes in grassland, the use of a weed licker can be a useful means of delivering weed control product directly to the target weed without applying it directly to other vegetation.

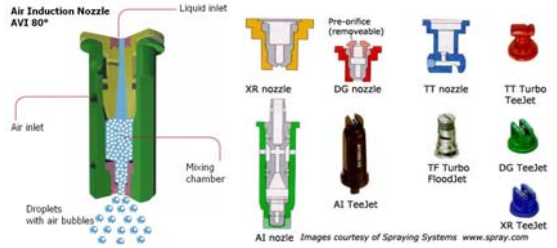
Use of seed dressings
Seed dressings by and large are considered to be very targeted in their deliver of the active substance to the site of possible damage. There are instances where such dressings deliver systemic control of certain pests.

Avoid insecticide use where bees are foraging

Bees and other pollinators are absolutely essential for the successful cultivation and production of a range of flowering broad leaved crops. Therefore, It is best practice to avoid the use of insecticides to these crops at times when bees and other pollinators are actively foraging.

Drift reducing methods

Spray drift can be reduced by increasing the droplet size i.e., make the droplet heavier. This can be achieved by decreasing sprayer operating pressure, using alternative wide aperture nozzles (bigger nozzles give bigger droplets), using flat fan nozzles instead of cone nozzles and using adjuvants and additives to alter the make-up and thus the density of the droplet. Keeping the boom height at optimum height above the crop will ensure uniform application but also will reduce potential for drift. Other methods concentrate on the weather conditions that prevail when spraying.



Use drift reducing nozzles

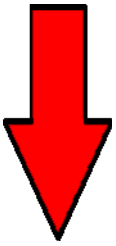
Equipping a sprayer with either standard drift reducing nozzles or extended pressure range nozzles, reduces the amount of spray vapour which will be blown off target. These can be either pre-orifice type which effectively reduces pressure at the spray tip or air induction type.

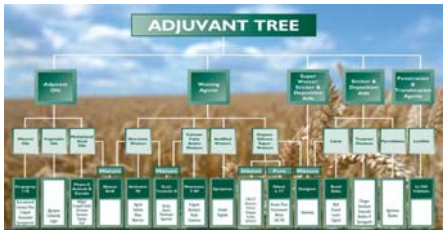
Use air assisted sprayer

Sprayers equipped with air assistance tend to be concentrated on two basic types. The first type is based on the Airtec nozzle which through an air injection system, envelopes air into the spray droplet. The other type is based on the presence of an air sleeve positioned directly over the spray boom, which during operation effectively blows the spray solution down onto or into the crop. Both types dramatically reduce the incidence of spray drift.

6. Use of pesticides at necessary levels			
Use reduced rates of application		Use adjuvants to reduce PPP use	
Partially treat / spot spray fields		Applications timed to minimise use	
Reduce frequency of application			
Other (please specify)			

Use reduced rates of application
In many crop production scenarios farmers/growers, as a matter of course, apply PPPs at rates well below the maximum allowed to control lower pest occurrence. This is considered to be good plant protection practice. E.g., control of weeds at cotyledon stage can be generally achieved at lower rates of herbicide than weeds at a more advanced growth stage.





Use adjuvants to reduce PPP use
In some instances the addition of particular adjuvants can enhance the efficacy of some PPPs. This in turn makes it possible to make reductions in the amount of PPP used.

Partially treat / spot spray fields
Frequently crop pests occur in hot spots or are particularly concentrated in some areas. Because of this it is sometime possible to spray sections of fields or spot treat areas. In orchards weed control is usually confined to the area immediately adjacent to the trees.

Applications timed to minimise use
It is frequently the case that a well timed application is more important than either product choice (within reason) or indeed product use rate (also within reason). Therefore to exploit the possibilities of reducing the overall amount of PPP used on a crop, the timing of the application should be given real consideration. It is acknowledged that because of weather/climate and scale of production it is not always possible to treat all crops at the optimum timing.

Reduce frequency of application
Depending on factors such as local weather, PPPs being used, cultivar being grown etc.. it is possible to reduce the frequency of application.

7. Anti-resistance strategies applied to maintain the effectiveness of the products			
Use products with multiple modes of action		Use robust rates of PPPs	
Use tank mixes with multiple modes of action		Keep abreast of resistance development	
Familiar with different product labels			
Other (please specify)			

Use products with multiple modes of action

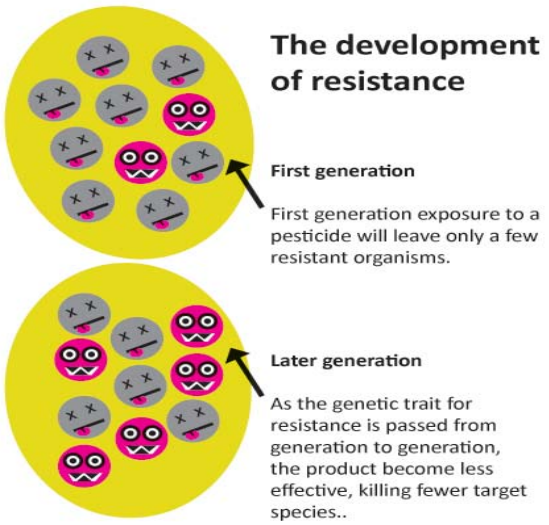
To hinder or delay the development of resistance, products containing a number of active substances with different modes of action that are effective against the target pests are necessary. This strategy may be also be carried out by tank mixing products with different modes of action.

Use robust rates of PPPs

Applying appropriate products at the right time and the right dose is critical for good field performance. Whilst a robust rate does not necessarily mean maximum rate, it will depend on the context of use and the mix of products being used. However, where likelihood of resistance is high, rates of application should reflect this.

Use tank mixes with multiple modes of action

The use of multiple different modes of action can be achieved by either tank mixing different products with different modes of action or by using products which contain many active substances with different modes of action. Alternating products with different modes of action in repeat spray programmes can achieve similar results.



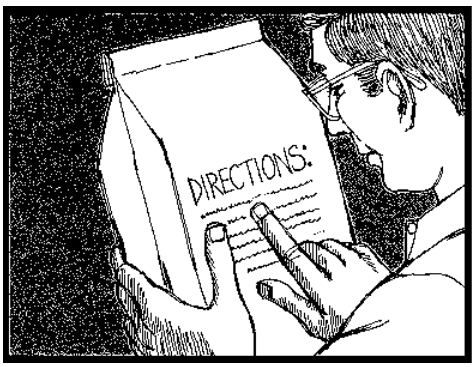
Keep abreast of resistance development

Absence of resistant pest populations and continued product usefulness at field level can make us complacent about the future development of resistance, even where such resistance has been identified elsewhere in the world. Resistance can arise rapidly and completely, so that field control can be lost in a single season. Avoid repeated applications of the same product or mode of action and never exceed the maximum recommended number of applications per crop.

Follow a resistance management strategy, timing application to the most vulnerable life stage of the pest and avoiding eradicant use of treatments.

Familiar with different product labels

Farmers/growers and advisors should be familiar with an array of different product labels. They should be acquainted with details of how and when products should be applied, as well as any precautions that are required around safe application of the product. Particular attention should be paid the type of chemistry and the existence of or the possibility of development of pest resistance to them.



8. Success of the applied crop protection measure			
Success or failure of intervention is measured		Member of discussion group	
Success or failure of intervention is recorded		Results discussed with advisor	
Crop yields are recorded			
Other (please specify)			

Success or failure of intervention is measured

Success on one farm or on one crop is never a guarantee of success on another farm or on another crop. Therefore, farmers/growers are required to observe whether the intervention technique used was actually successful or not. If the intervention was not successful, then there should be a reason as to why not. This should facilitate and enable a better strategy to be adopted in subsequent years. The measure of success can include recording quality, yield or other measurable biometrics such as crop height, number of spikelets or number of tillers etc…

Member of discussion group

Discussion groups generally convene a number of times per year. They are usually facilitated or moderated by an advisor. They act as a valuable channel for the sharing of ideas and experiences in all aspects of production and farming. The exchange of information and problem solving suggestions can be hugely beneficial to individual members.

Success or failure of intervention is recorded

It is good practice to record the success or failure of measures. This can be done in a field notebook or field diary etc..

Crop yields are recorded

The recording of crop yield is something that every farmer/grower does. However, individual fields or farms are sometimes not measured separately. The recording of individual field yields is not only good practice but it greatly enhances the extent of information available to the farmer/grower and advisor for the future management of crops in that location.

Results discussed with advisor

Measuring and recording the various results of interventions is somewhat pointless, unless it is used as part of the decision making process for subsequent cropping and plant protection decisions. Whether it is through the mechanism of discussion groups or an advisor it is important to discuss the success or failure of strategies to enable better decisions to be made in the future.

Application of Integrated Pest Management (IPM) at user level.

Herd Number: _____ Year: _____

Tick only the appropriate options currently practiced on your farm.

1. The prevention and/or suppression of harmful organisms			
Crop rotation	☐	Sterile seedbed technique	☐
Clean machinery and equipment	☐	Clean potato boxes/growing trays etc..	☐
Nutrient management programme	☐	Irrigation (applied to schedule)	☐
Soil testing (pH, nutrients, OM)	☐	Protect beneficial organisms	☐
Certified seed	☐	Full inversion tillage (plough)	☐
Choose disease resistant varieties	☐	Minimum cultivation	☐
Management of crop residues	☐	Soil structure & compaction	☐
Use of optimal sowing date	☐	Clean crop storage areas	☐
Other (please specify)			
2. Monitoring of harmful organisms			
Use early warning/forecasting systems	☐	Monitor crops for pests/diseases	☐
Use weather forecast to aid decisions	☐	Advisor monitors crops	☐
Can identify main pests	☐	Use traps/sticky pads/lures	☐
Other (please specify)			
3. Application of plant protection measures			
Some crops treated preventatively	☐	Advisor makes decision	☐
Decisions jointly made with advisor	☐	Some decisions based on pest thresholds	☐
Other(please specify)			
4. Sustainable biological, physical or other non-chemical methods			
Use natural enemies	☐	Use crop fleeces	☐
Use micro-organism plant protection products	☐	Use crop netting	☐
Use propane burners for weed control	☐	Use mechanical weeder (e.g., steerage hoe)	☐
Use manual methods	☐	Use deterrents (bangers, kites etc..)	☐
Use of topper/mower for weed control	☐		☐
Other (please specify)			

5. The pesticides applied shall be as specific as possible for the target pest.			
Applications usually for multiple pests	☐	Resistance development is considered	☐
Different modes of action considered	☐	Broad spectrum products avoided	☐
Different products considered	☐	Familiar with different product labels	☐
Economics are considered	☐	Use advisor to help decide on product(s)	☐
Consider following crops	☐	Buffer zones are considered	☐
Use weed licker for weed control	☐	Use of seed dressings	☐
Avoid insecticide use where bees are foraging	☐	Use drift reducing nozzles	☐
Use air assisted sprayer	☐	Other drift reducing methods	☐
Other (please specify)			
6. Use of pesticides at necessary levels			
Use reduced rates of application	☐	Use adjuvants to reduce PPP use	☐
Partially treat / spot spray fields	☐	Applications timed to minimise use	☐
Reduce frequency of application	☐		☐
Other (please specify)			
7. Anti-resistance strategies applied to maintain the effectiveness of the products			
Use products with multiple modes of action	☐	Use robust rates of PPPs	☐
Use tank mixes with multiple modes of action	☐	Keep abreast of resistance development	☐
Familiar with different product labels	☐		☐
Other (please specify)			
8. Success of the applied crop protection measure			
Success or failure of intervention is measured	☐	Member of discussion group	☐
Success or failure of intervention is recorded	☐	Results discussed with advisor	☐
Crop yields are recorded	☐		☐
Other (please specify)			

Herd No:_____ **Pesticide Application Record** **Year:_____**

Product Name (Trade Name)	**PCS Number** (as printed on product label)	**Location LPIS No.**	**Crop** **(Winter or Spring)**	**Area/tonnage treated** **e.g. Ha or tonnes**	**Quantity applied** **e.g. L/Ha, Kg/ha**	**Date applied**	**Rationale / Reason** **(pest present, preventative treatment, resistance management, threshold exceeded, crop damaged etc…)**

Notes: