POINT SOURCES

Best Management Practices to reduce point sources.

TOPPS
Water Protection

ABOUT TOPPS

TOPPS stands for "Train Operators to Promote best management Practices & Sustainability"

The TOPPS projects started in 2005 with a 3-year EU-Life programme co-funded project to reduce losses of Plant Protection Products (PPPs) to water from point sources. The initial point sources project was conceived as a multi-stakeholder project including 15 EU Member States, 12 local partners and 9 subcontractors.
Follow-up phases of the TOPPS project since 2008 have extended into more countries (Point source projects in 23 countries), and broadened the scope of the project to also address reduction of diffuse sources (diffuse source projects in13 countries). TOPPS now offers a broad set of Best Management Practices (BMPs) covering point and diffuse source entry pathways into water. Aspects such as sprayer optimization and infrastructure are also included in the context of their potential to reduce the risk for water contamination through Plant Protection Product losses.

Further information for farmers, advisers and stakeholders (booklets, flyers, presentations, training courses, as well as a picture and video gallery can be found on the TOPPS websites:

www.TOPPS-life.org (Documents site)
www.TOPPS-drift.org (Online tool for drift risk and mitigation)
www.TOPPS-eos.org (education tool on how to optimize sprayers for more water protection)

TOPPS projects develop and recommend BMPs developed together with European experts and stakeholders. Intensive dissemination through information, training and demonstration is conducted in European countries to create awareness and help implement better water protection.

This booklet is a second updated edition of the point source BMPs.

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Pictures:
originate from our TOPPS partners, USDA, experts

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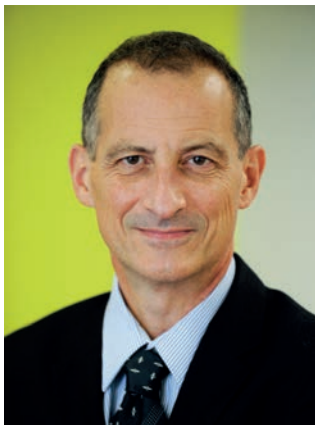

FOREWORD

ECPA sees protection of water as a key pillar of its work and is determined to continuously improve the correct use of pesticides to help underpin sustainable and productive agriculture.

We therefore set ourselves the task of working together with our own national associations and a broad group of international partners to develop and disseminate appropriate measures, recommendations and training materials to ensure that all relevant aspects of water protection are addressed, and that broad consensus is achieved on the recommended measures (referred to as Best Management Practices – BMPs).

This collaborative effort to build and improve available tools for water protection also fits very closely with the objectives contained in relevant EU legislation such as the Water Framework Directive (WFD) and the Sustainable Use of Pesticides Directive (SUD). This effort has resulted in the multi-stakeholder TOPPS projects which have now been running for more than 12 years. The first phase of the project was launched in 2005 in 15 EU countries with a focus on reducing point sources (such as spills, or inappropriate equipment cleaning practices), and this was 50% co-funded by the EU Life programme.

It is now time to update this point source BMP brochure, and we hope that you will find this refreshed edition improved and useful.

The ongoing multi-partner TOPPS project phases have now extended the work to 23 countries, and broadened the available BMPs, diagnosis tools, and training materials beyond point sources. These now also cover the key diffuse emission routes to water (primarily spray drift and run-off/erosion), and a further addition of measures on drainage and leaching is planned in due course.

The TOPPS project approach seeks to address the whole Crop Protection process, and to raise awareness of potential to reduce losses to water through optimized sprayers and infrastructure.

It is our hope that the resulting BMPs will be used as a basis to inform, educate, and train operators, advisers and stakeholders in a range of different ways – in the classroom, in the field, and through demonstration. ECPA is committed to promoting the implementation of these BMPs.

I would like to thank all the partners and experts for their great efforts and contributions to the TOPPS projects, both in terms of the technical know-how they have brought to the table, and their willingness to work together to achieve consensus on our common goals. I also hope that these BMPs will help spark the enthusiasm that will be needed to implement these recommendations "on the ground" and help create awareness and spread the knowledge which is necessary for the sustainable use of pesticides and a high level of water protection.

Jean-Philippe Azoulay
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European Crop Protection

INTRODUCTION - LEGAL FRAMEWORK

In the EU the authorisation and use of Plant Protection Products (PPPs) is managed in the context of a legal framework that sets the rules for their marketing and use. This framework is based on the principle of ensuring a high level of environmental protection, and the key EU regulations and directives are described below.

Regulation of PPPs

Regulation (EC) No 1107/2009

The purpose of this Regulation is to require evaluation and testing of PPPs in order to ensure a high level of protection of human and animal health and the environment, and at the same time to safeguard the competitiveness of the EU's agriculture sector. The Regulation has the objective of ensuring that substances or products produced or placed on the market do not have harmful effects on human or animal health or any unacceptable effects on the environment.

Directive on Sustainable Use of Pesticides

Directive 2009/128/EC

This Directive focuses on the use phase of PPP and lists the following actions that Member States must undertake:

- Set up National Action Plans (NAPs) containing objectives and timetables to reduce risks and impacts of pesticide use;
- Training: Professional pesticide users, distributors and advisors receive proper training on the safe use and handling of PPP;
- Establish competent authorities and certification systems;
- Minimise or prohibit PPP use where necessary in certain critical areas for environmental or health reasons;
- Inspecting application equipment in use: All PPP application equipment should have been inspected at least once by 2016 (except handheld equipment).

Water Framework Directive (WFD)

Directive 2000/60/EC

The WFD establishes a framework for EU level action in the field of water policy. It required that good water status should be achieved by 2015, and that any deterioration of water quality should be halted or reversed where possible. The Directive places the following responsibilities on Member State authorities:

- identify the individual river basins in their territory
- designate authorities to manage these basins in line with the EU rules;
- analyse the features of each river basin, including the impact of human activity and perform an economic assessment of water use;
- monitor the ecological and chemical status of water bodies in each basin;
- register protected areas, such as those used for drinking water abstraction, which require special attention;
- produce and implement River Basin Management Plans (RBMPs) to prevent deterioration of surface water, protect and enhance groundwater and preserve protected areas;
- provide public information and consultation on their RBMPs.

The WFD provides the framework within which the Directives for ground water (2006/18/EC), drinking water (98/83/EC) and surface water and the Environmental Quality Standards (EQS) (2008/105/EC) operate. These provide targets concerning the chemical quality of groundwater and surface water. For treated at-the-tap drinking water, and ground water a precautionary limit value for PPPs has been set at 0,1 µg/l. In surface water, substance specific quality standards (EQS) are established, to ensure that there are no unacceptable effects on aquatic organisms (including indirect effects through the food chain).

The 0,1 µg/l threshold value is equivalent to 1 gram of active substance in 10 million litres of water and represents a close to zero tolerance for PPPs in drinking and ground water (Fig.1). This stringent value means that even very little contamination can lead to non-compliance with the EU requirements.

The only practical means of reaching the ambitious objectives required by the WFD, while still ensuring that EU farmers have access to the weed, pest and disease control that they need in order to remain competitive is for local risk assessments to be performed, and for suitably adapted Best Management Practices (BMPs) to be implemented where appropriate.

Machinery Directive

Directive 2006/42/EC and amendmending
Directive 2009/127/EC

The Directive states that the design, construction and maintenance of machinery used for pesticide application play a significant role in reducing possible adverse effects of pesticides on human health and the environment. Regarding pesticide application equipment that is already in professional use, the Directive introduces requirements for the inspection and maintenance to be carried out on such equipment.

The amendment of the Directive in 2009 included provisions for Member States to withdraw from the market or prohibit machinery which is liable to endanger human health and safety, or the environment where applicable.

Machinery for pesticide application must be designed and constructed so that the machinery can be operated, adjusted and maintained without unintended exposure of the environment to pesticides, and the following relevant requirements are laid down in the Directive:

- **Controls and monitoring**
  It must be possible to easily and accurately control, monitor and immediately stop the pesticide application from the operating positions.

- **Filling and emptying**
  The machinery must be designed to facilitate precise filling with the necessary quantity of pesticide and to ensure easy and complete emptying, while preventing spillage of pesticide and avoiding the contamination of the water source during such operations.

- **Application of pesticides**
  The machinery must:
  be fitted with means of easily adjusting the application rate;

  be designed to ensure that pesticide is deposited on target areas, to minimise losses to other areas and to prevent drift of pesticide to the environment;

  be designed to prevent losses/ drips while the pesticide application function is stopped;

  and be subjected to relevant tests by the manufacturer or his representative to ensure compliance with the requirements.

- **Maintenance**
  The machinery must be designed to allow easy and thorough cleaning, and to facilitate servicing and changing of worn parts without contamination of the environment.

- **Inspections**
  It must be possible to easily connect the necessary measuring instruments to the machinery to check correct functioning.

- **Marking of nozzles, strainers and filters**
  Nozzles, strainers and filters must be marked so that their type and size can be clearly identified.

- **Indication of pesticide in use**
  Where appropriate, the machinery must be fitted with a specific mounting on which the operator can place the name of the pesticide in use.

- **Instructions**
  The instructions must provide relevant information in order to facilitate correct operation of the equipment and to avoid contamination of the environment, including but not limited to the following:

  - precautions to be taken during mixing, loading, application, emptying, cleaning, servicing and transport operations;
  - detailed conditions of use for the different operating environments envisaged;
  - the range of types and sizes of nozzles, strainers and filters that can be used with the machinery;
  - the frequency of checks and the criteria and method for the replacement of parts subject to wear that affect the correct functioning of the machinery, such as nozzles, strainers and filters;
  - specification of calibration, daily maintenance, winter preparation and other checks necessary to ensure the correct functioning of the machinery;
  - types of pesticides that may cause incorrect functioning of the machinery;
  - an indication that the machinery may be subject to national requirements for regular inspection by designated bodies, as provided for in Directive 2009/128/EC on the sustainable use of pesticides.

Fig 1. If 1 gram PPP active ingredient enters a water body, it takes a ditch 1 m wide, 30 cm deep and 33 km long to dilute it to the drinking water threshold of 0,1µg/l

ENTRY ROUTES OF PLANT PROTECTION PRODUCTS INTO SURFACE WATER

PPPs can enter surface water bodies through different routes. Most important are the losses of PPPs from point sources (originating from the farmyard) and diffuse sources (originating from treated fields, e.g. surface runoff/soil erosion, drainage and spray drift) (Fig. 2).

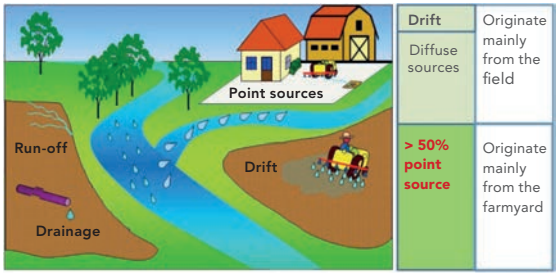


Fig. 2 Pathways of PPP into surface water and their significance

Point source contamination

Point sources represent the most important transfer pathways of PPPs into surface water. Research has shown that point sources can represent from 40% up to 90% of the contamination measured in surface water bodies if preventive measures are not taken. Point sources originate from farm yard operations such as loading of PPPs during preparation of spray mixtures. The greatest risk areas contributing to PPP losses to water from point sources are:

a) the cleaning of the sprayer
b) the filling of the sprayer
c) the management of remnants, including tank left-overs, on the farmyard (i.e. on hard/concrete surfaces)

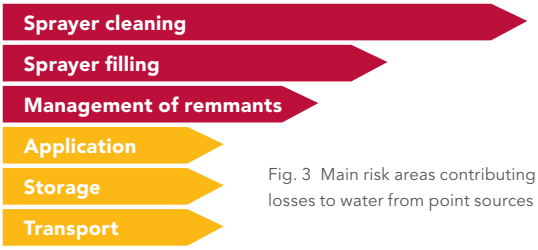


Fig. 3 Main risk areas contributing to PPP losses to water from point sources

Second-tier risk areas are:
d) spills during the application of PPPs
e) the storage of PPPs
f) leakages during sprayer transport from the farm to the field and from the field back to the farm

However, these second tier risks can also pose a high risk for example in case of road accidents or fire in the storage area (Fig. 3).
While diffuse sources can only realistically be reduced due to the fact that it is not possible to control wind and rainfall, point source contamination can be avoided almost completely by adopting the correct behaviour when using and handling PPPs, and this includes ensuring the availability of optimized spray equipment and proper (on-farm) infrastructure.

How is point source contamination measured?

If preventive measures are not taken, emissions from the farm yard alone can contribute up to 50% or more of the total contamination measured in surface waters. This has been demonstrated and measured in a number of field studies conducted in farmed areas. Point source contamination may be measured using the methodology described in Fig. 4.
In this case farms located within one municipality are connected to the same sewage plant. This plant also collects water from the connected farmyards. PPP residues are measured at the outlet of the sewage plant. These are the measured point sources. Diffuse source contamination is measured at a point where the water body can only carry contamination coming from agricultural fields. Results typically show that about 40% to 90% of PPP contamination in water courses originates from the farm yard point sources.

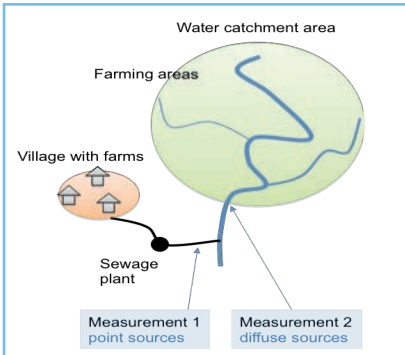


Fig. 4 Method of measure significance of point and diffuse source entrance

Diffuse source contamination

Diffuse sources originate from the application of PPP in the field. Critical PPP transfers to water are: i) field run-off/erosion from soil surfaces due to rain precipitation shortly after product application, ii) transfers due to wind as spray drift during product application and iii) entries from subsurface water transfers through drainage. Best Management Practices (BMPs) to reduce PPP contamination from diffuse sources are described in the TOPPS-Prowadis booklets (www.TOPPS-life.org)

DEVELOPMENT OF BEST MANAGEMENT PRACTICES (BMPs)

Key factors and relevant working processes to reduce losses of PPPs to water

BMPs were developed by the TOPPS project teams by collecting already existing BMPs, determining gaps where no BMPs existed or were these were considered insufficient. The TOPPS draft BMPs were presented at national forums to a wide range of stakeholders in order to finalise the proposed BMPs and to take into account stakeholder comments. It is expected that broad involvement of stakeholders will help to obtain acceptance for the proposed BMPs and support for their implementation.

BMPs were developed in line with three key factors that are considered relevant:
1) correct behavior,
2) improved technology (e.g. optimized sprayers) and
3) improved infrastructure.
These three factors are of importance for each of the 6 key working processes displayed in Fig. 5.

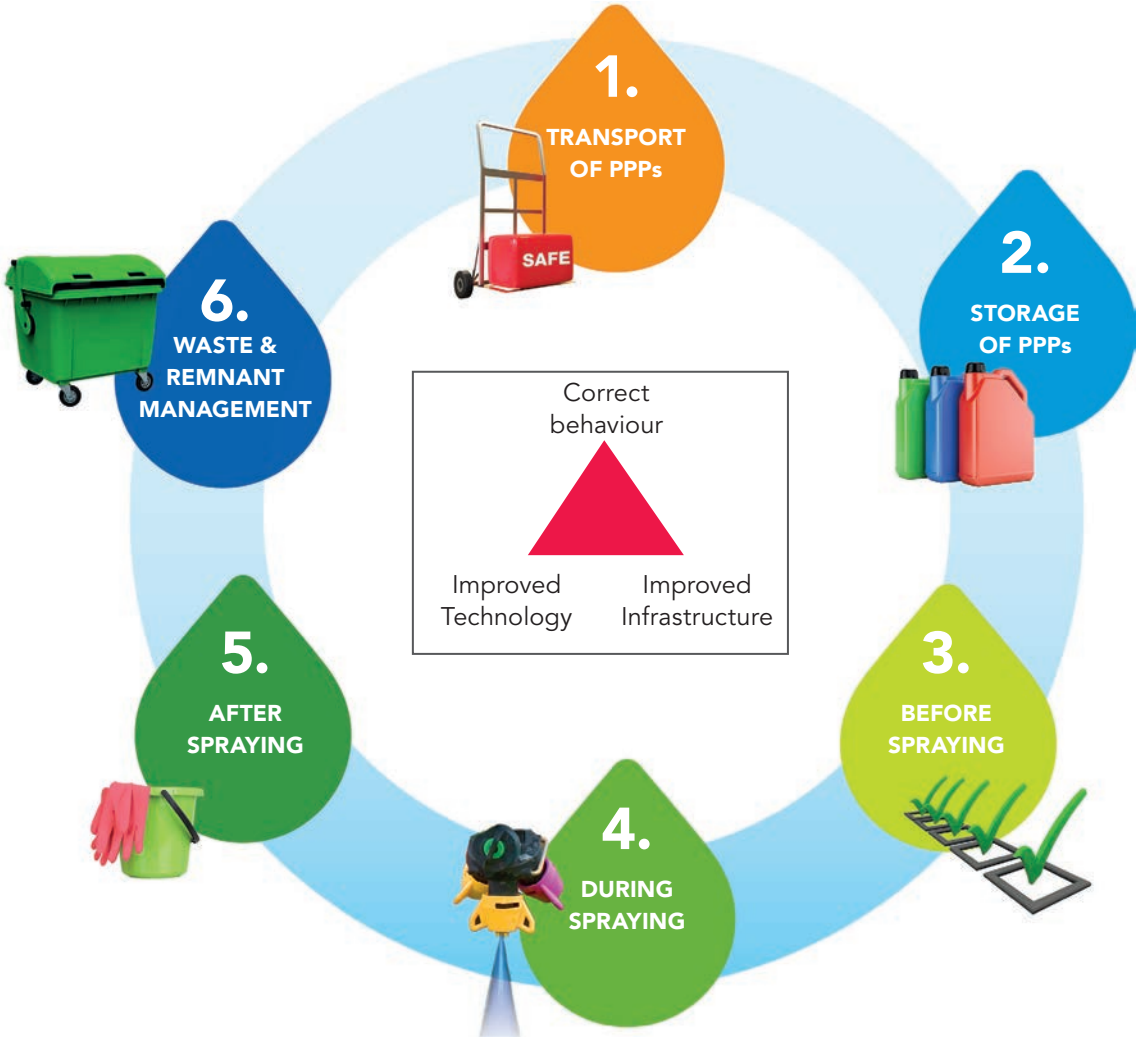


Fig. 5 Key factors and working processes to avoid point pollution sources.

SUMMARY OF KEY BMPs

Each drop of PPP reaching water is too much. Reducing PPP losses starts with the careful handling and use of PPPs. This is why Best Management Practices (BMPs) are recommended to be followed when handling and using PPPs.

Please note that local rules and regulations may vary across the EU. We recommend reviewing these.

TRANSPORT

Always consider the following aspects:

1. Transport of PPPs concentrates from retailer to farm
2. Transport of spray liquid in the spray tank/PPP concentrate from farm to field

Transport regulations across EU may vary and need to be checked locally.

a) From retailer to farm

- Use your supplier's delivery service for the transport of PPPs to your farm whenever possible.
- Check containers if they are in their original package and not damaged.
- When transporting PPPs on your own, use secure and lockable boxes which can contain spills in case of an accident.
- Do ensure load is safely stowed and secured.
- Do not transport PPPs together with food or feed.
- Have a mobile phone and emergency numbers with you in case you need help.

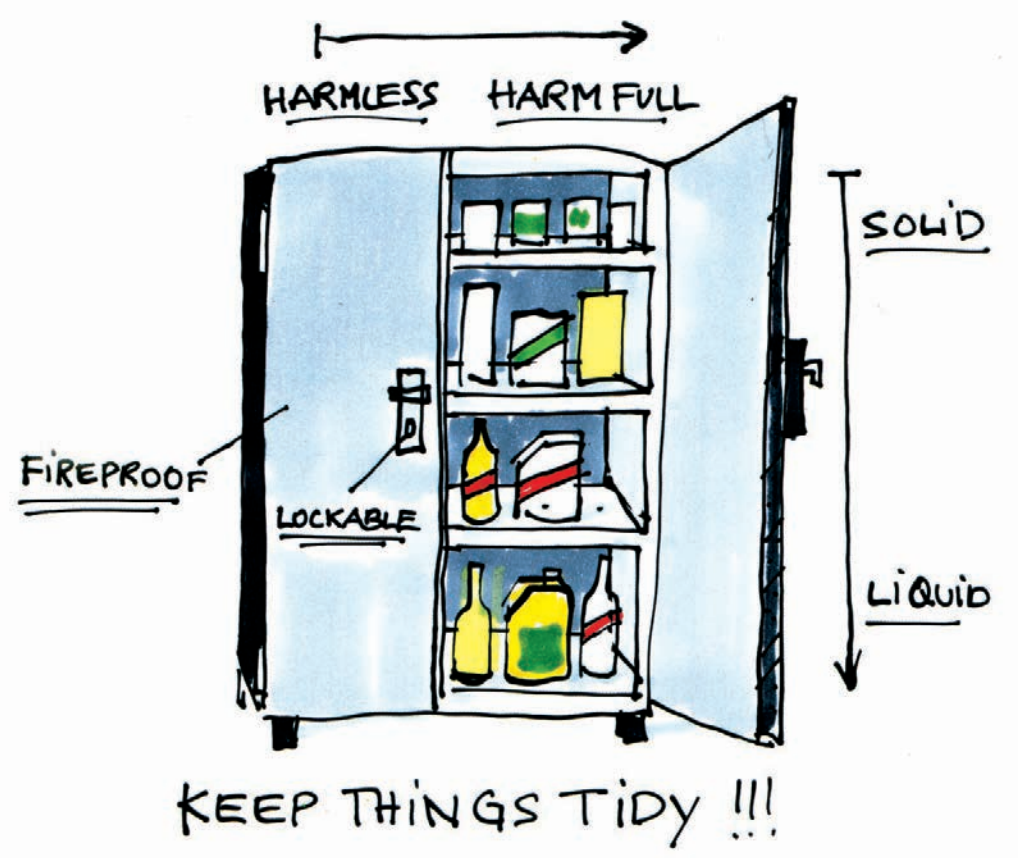
b) From farm to field

- Follow the local transport rules if you carry PPP concentrate or spray liquid on your sprayer
- Use lockable transport boxes for PPP concentrates
- Check the sprayer for leakages before travelling to the field
- Sprayer pump should be turned off, when driving the sprayer to the field.
- Choose access roads to the field which have the lowest risks for accidents to occur
- Travel carefully to avoid overturning of sprayer

STORAGE

A storage area specifically designed and designated to store PPPs is an essential infrastructure. Access to PPP storage should only be given to authorized persons. Check and follow local requirements for storage of PPPs. (In some countries storage conditions are regulated and are cross compliance relevant). Plan the location of the storage carefully to reduce the risk of fire and flooding. Ensure sufficient ventilation and be prepared to act quickly in case of emergency situations (e.g. fire extinguisher, emergency numbers). Storage areas should be designed as such that a spillage of 10% of the liquids stored could be contained. Ensure that floor of the the storage facility does not provide a direct connection to water.

- Check if local requirements exist for storage
- Control access to the storage area and signpost the store with warning symbols
- Dry products should always be located on the top shelves and liquid products on the low shelves (in case of leaks dry products are not contaminated by liquids)
- Have sorbent materials (e.g. sand, saw dust) at hand to manage spills
- PPPs should be stored in their original and undamaged packages with their labels clearly readable
- Limit the storage of PPPs to those for which you have a planned use.
- Have emergency numbers, emergency plans and stock documentation up to date and accessible.



BEFORE SPRAYING

Good planning is very important before spraying:
Select the PPPs and ensure that application is executed at the right time, at the right place and at the right amount, Define the field(s) that need spraying, consider environmental factors that may affect spraying, mark/identify sensitive areas adjacent to the field and choose the least risky route to the field.

The biggest point source risk before spraying is the filling and loading activity, as well as leakages when driving to the field.

Make sure that empty containers are triple-rinsed with water. Washing water should be filled into the spray tank. Empty containers need to be stored at a secure and dry place and should
be given to authorized waste collection services that are established in most countries. Follow the guidance of the collection service operators.

- Read and follow product labels carefully
- Identify sensitive areas such as water protection zones, springs, wells and consider required buffer zones
- Check the regional weather forecast for the area you intend to spray
- Make sure that the sprayer is correctly adjusted and calibrated for the intended application
- Fill the sprayer on a biological active area (soil/field) or on a hard surface, which allows the collection of PPP spills and potential tank overflow

- Be prepared to manage any spills by having sorbent materials at hand (saw dust, sand, other).
- If the filling is done in the field, alternate the filling place and keep a distance to water of at least 10 m.
- Use technical tools which reduce the risk of spills, e.g. induction hoppers, closed transfer systems, etc.
- Ensure that spray liquid cannot contaminate your water source when filling the sprayer with water (e.g. backflow valve). Do not source water directly out of a ditch or pond. Take sufficient freshwater with you in a separate tank to enable rinsing of the sprayer in the field.
- Never leave a sprayer unattended during filling.
- Check sprayer for leakages and switch off the pump during the drive to the field.
- Select and use the least risky road to the field (accidents).
- Use sprayers which have been inspected.
- Empty containers must be rinsed 3 times with water.
- Empty containers need to be stored dry in a secure place ready to be picked up by an authorized waste collection service (always follow their guidance).
- Make sure that empty PPP containers are not used for other purposes.

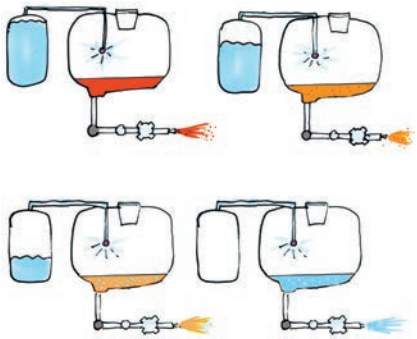
DURING SPRAYING

During spraying, if proper measures are not taken in and at the border of the agriculture field, diffuse source contamination may be the main contributor to water contamination by PPPs. Some specific aspects are relevant for point source reduction. These are mainly related to unintended over spraying in or next to water courses, and the contamination of field access roads when turning the sprayer (especially a concern in narrow vineyards).

- Never overspray water bodies
- Do not spray into water courses, wells or drainage ditches
- Shut off the sprayer when turning; do not overspray roads/hard surfaces
- Spray headlands last
- Maintain correct boom height (usually 50 cm or less above canopy/soil surface)
- Leaks and drips on sprayer must be repaired as soon as possible
- Reduce drift and never overspray buffer zones (see spray drift reduction BMPs)

AFTER SPRAYING

Cleaning of the sprayer after product application is one of the most important activities with regard to reduce point source contamination. Even if air blows out of the nozzles, due to technical limitations the sprayer is not completely empty: a technical residual volume remains in the sprayer. The technical residual volume varies among types of sprayers. The actual residual volume is bigger if the sprayer has not been correctly calibrated or carries a „reserve" of spray liquid. Freshwater should be carried in a separate tank to rinse the sprayer and to ensure that as little contaminated liquid as possible is returned to the farmyard.



Correct rinsing of the sprayer in the field is paramount to reduce the point source potential.

Basically there are three different rinsing procedures:

a) Manual rinsing

Rinse water is filled three times (3 x 1/3 of rinse water capacity) into the spray tank and sprayed out three times in the last treated field through the sprayer pump. The needed dilution factors are only achieved if the procedure is repeated at least 3 times.

b) Continuous rinsing

A second pump delivers the rinse water via an internal rinse nozzle (or similar) continuously into the main tank, meanwhile the sprayer pump pumps out the diluted residual volume in the field.

c) Automatic systems

Bigger and well-equipped sprayers have an automatic and integrated rinsing system.

Residual volumes for field crop sprayers are higher (pipes and booms) compared to bush and tree crop sprayers (less pipes, but often higher PPP concentrations being applied).

- Rinse the sprayer in the last treated field: multiple rinsing achieves better dilution of the residual volume.
- Spray diluted volumes out in the last treated field, if possible on an area reserved for the cleaning procedure.
- Clean the outside of the sprayer in the field, if possible.
- If technical equipment is not available to allow outside cleaning in the field, clean the outside on a biological active area/soil close to the farmyard or on a hard surface, which allows the collection of the washing water.
- Check label information if applied products require additional sprayer cleaning procedures.
- Clean soil/mud from tractor/sprayer tyres before leaving the field.

- After use, park the sprayer in a secure area and under a roof to protect it from rain washing off any remains of PPPs.
- Record information relating to all spray applications (place, time, PPP, quantity).

WASTE AND REMNANT MANAGEMENT

If the rinsing procedure is well done in the field, very little contaminated liquid returns back with the sprayer to the farm. Sprayer manufacturers need to inform about the efficiency of their sprayers' rinse systems in the sprayer handbook. Not all necessary cleaning operations can be practically managed in the field (e.g. cleaning of filters, cleaning of nozzles, diluted residual volumes). Likewise, spills and leakages may occur during operations on the farmyard, which need to be properly managed. Reducing remnants starts with the careful handling and use of PPPs.

- Wash your sprayer on a biologically active area (i.e. soil) or on a dedicated washing place with a hard surface, where washing water can be collected.
- Store your triple-rinsed PPP containers in a way that they can dry out; pack and store them as required by the local recycling/disposal scheme.
- Wash container caps and seals carefully as they may carry remnants of PPP concentrate.
- Maintain your sprayer so that no spray liquid from spills or leaks can reach water; some filter cases may release spray liquid when opened.
- Treat collected contaminated washing water with appropriate techniques: biological, physical and chemical solutions are available (e.g. biofilter, osmofilm, heliosec, etc.).
- Participate in authorised container recycling/disposal systems.
- Never burn or bury PPP containers or packages.
- Never wash pesticide remnants down the drain.
- Emergency phone numbers and emergency plans should be readily available at the farm.

BEST MANAGEMENT PRACTICES (BMPs)

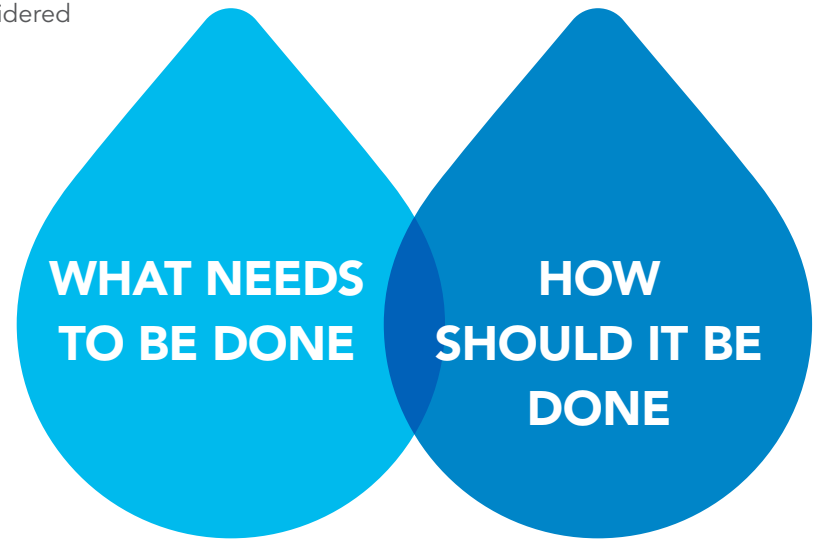
detailed checklist to reduce the risk of PPP water contamination through point sources

Best Management Practices (BMPs) highlight where plant protection products may pose a risk for losses to water and how such risks can be mitigated. It is recommended to always keep BMPs up to date based on current practices and changing legal requirements. The BMPs are structured on the basis of key working processes from transport of PPPs to remnant/waste management.

Statements are intended as recommendations to implement the appropriate BMPs. Specifications should be considered as a proposal supporting their implementation.

The statement:
WHAT NEEDS TO BE DONE

is followed by specifications:
HOW SHOULD IT BE DONE



Statements and specifications are intended to be used as a checklist to help support a self-audit of the situation in order to reduce the risk for PPP losses to water.

BMPs do not supersede any relevant local regulations, laws and application guidelines, which shall always prevail. Therefore, a previous alignment with local authorities/ consultants is recommended.

TRANSPORT OF PLANT PROTECTION PRODUCT (PPPs)

a) Transport from retail to farm

Professional distributors are aware of the legal obligations concerning the transport of plant protection products. They are also able to give guidance to farmers on transport regulations.

The road transport of chemical products is extensively regulated. Follow strictly the safety instructions of the supplier and/or the instructions on the product labels. Check that the correct and genuine products (beware of counterfeit products) are delivered with properly labelled packaging in good condition. These precautions avoid unnecessary transport of these products and hence contribute to reduce the risk of contaminations.

b) Transport from farm to field

Structural changes in agriculture (less farms/bigger fields), have increased the average distances from farm to field, resulting in an increased risk of accidents during transport. Therefore, careful planning of the route to the field is important. Be informed on local regulations for transport of spray liquid in the sprayer or PPP concentrates.

DO

Transport Plant Protection Products in their original containers with intact, readable labels:

- Individual containers taken from pallet may not conform to safe transport requirements.
- Keep plant protection products separate from drivers and passengers with a chemical and vapour proof barrier (Transport box).

Keep mobile phone and emergency telephone numbers at hand

- Keep emergency numbers (police, fire, ambulance, environment agency) safed in your mobile phone and with you at all times.
- Use Environmental Protection Agency Hotline in case of a risk of Plant Protection Product reaching water.
- Always know your position (so that you can communicate, if needed).

Have check lists and equipment for use in emergencies available (e.g. road accidents)

- You should know the emergency measures; if not, ask your local adviser.
- Have a list of the plant protection products available, and use corresponding warning indications for the transport.
- Ensure instant availability of emergency equipment to cope with spills and leaks.

AVOID

Transporting unnecessarily large amounts of Plant Protection Products

- Only transport the quantities needed for the immediately planned activity.
- All product must be transported within secured containers
- Mobile stores must only be stocked from fixed stores; plant protection products are to be used within 24 hours.
- Specific regulations may be applicable for plant protection products labelled „Toxic“, „Flammable“ or „Corrosive“.

DO

Avoid impact damage whilst on/off loading

- Manual and/or mechanical movement of Plant Protection Products must not damage their packaging.
- Check that loading space, pallets and stillages are free of sharp protrusions.
- Check pallets, packs, containers for damage before and after loading.

Ensure load is safe and secure before departure

- Use a clean, dry, safe, spill-retaining loading space in vehicle.
- Implement specified handling requirements such as „This Way Up".
- Follow guidance on stacking heights.
- Prevent free movement of containers within load area.
- Avoid excessive stress on containers by security restraints.

Safely transport Plant Protection Products around farm in mobile stores/transport boxes

- Make sure mobile store is lockable and mounted safely.
- Check that mobile stores are able to contain any spills or leaks resulting from vibration or damage during transport.

Safely transport spraying equipment/Plant Protection Product and ensure vehicle stability

- Sprayers containing undiluted or diluted Plant Protection Products must not pose unacceptable risk during transport.
- Plant Protection Products, waste/remnants, empty containers must be stowed with caps refastened.
- Check coupling pins and other fastening devices for security before moving.
- Check tank fastenings to avoid vibration damage during traveling.
- Correctly ballast the vehicle and balance load in case of mounted sprayers.
- Drive carefully, avoid overturning of sprayer, and uneven roads if possible.
- Do not transport Plant Protection Products in the same space with humans, animals, farm produce or animal feed.

DO

Ensure no accidental/unintended losses of Plant Protection Products can occur

- Plant Protection Products must not leak, slop or pose hazards during transport.
- Tank lid must allow air in but prevent any leakage.
- Make sure hoses and nozzles are not leaking and that the tank is not overfilled.
- Close all valves that direct spray liquid to booms.
- Secure all valves against accidental opening during transport.
- Ensure spray tank fill level display is visible from the cabin to detect losses while on the way.
- Ensure tank closures, couplings and valves controlling liquid flow are tight.
- Rectify/repair equipment issues immediately.
- Clean tyres and recheck sprayer for leaks and external deposits when returning from field.

Do not drive through or in water courses

- Avoid driving through a water course when accessing a field or returning to the farm.
- Minimise crossing of water courses via bridges with the sprayer (reduce risk for accidents)

Be prepared for and manage spills safely

- Wear personal protective equipment [PPE] as defined on label and/or Safety Data Sheet.
- Separate damaged from undamaged containers/packs.
- Place damaged containers/packs within a sealable container/sack.
- Contain and absorb spills.
- Sweep up bound contaminants and place them within sealable containers/sacks to be managed as remnants.


HARDI
COMMANDER
MULTI TRACK

STORAGE OF PLANT PROTECTION PRODUCTS

Conditions for storage of Plant Protection Products on farms are regulated to ensure human and environment safety. These TOPPS BMPs are not directed at professional suppliers (retailers/distributors) that have to fulfil other conditions compared to farm storage. Farm stores are usually within, or adjacent to, farm buildings and hence part of the farm "infrastructure". Storage facilities must take into account all relevant legislation and safety issues. Mobile stores/transport containers (for PPP concentrates) must meet all relevant safety requirements. It is important that storage facilities are disconnected from drains/connections to water bodies. Leakages need to be contained within the store. In everyday use of Plant Protection Products, some small unintended spills and splashes may occur. These spills should be taken up by appropriate absorbent material and contained in a specific container/sack (remnants).

Location:
The location of the PPP-store is crucial to safety, labour efficiency and accessibility. Keep working distances between the store and the areas used for mixing/loading as short as possible. Shorter distances increase safety and labour efficiency

Access:
Laws/local regulations and other conditions may specify minimum standards for door labelling, access rights for entering the store and its general accessibility for emergency services. Appropriate accessibility conditions supports safe handling of Plant Protection Product containers whilst moving in/out.

Spills:
When working with liquids, spills may happen. Spills must never be ignored as they are a major risk for point source pollution. Spills must be cleaned up promptly and effectively. Do not allow any Plant Protection Products to be transferred, neither intentionally or by accident, into drains and gullies connected to surface water or sewage systems.

Emergency:
Be prepared for emergency situations such as fire, flooding or any other accidental hazard (follow an emergency plan). Quick and appropriate responses may prevent personal contamination as well as limit damages. Do have appropriate personal protective equipment to wear and liquid-absorbing materials ready for immediate use at all times.

DO

Locate store away from all sensitive zones to minimize risks

- Check with Environment Agency and local Authorities for suitable locations.
- Do not set up stores close to water protection areas.
- Follow the advice with regard to storage of plant protection product from respective authorities.
- Stores should not be located in areas prone to risk of fire, flood or other damage.

Provide appropriate mixing and loading facilities adjacent to store

- Plant Protection Products removed from store must always be in sight when being prepared for use.
- Mixing and loading sites must be capable of retaining all spills.
- Mixing and loading sites must have collection facilities for emptied and cleaned containers and packaging.

Store Plant Protection Products within lockable rooms/ containers or cupboards

- Use external secure locks with internal emergency release.
- Keep store key at a secure place.

DO NOT

Leave the store unattended and/or unsecured

- Stores must be secure and protected from unauthorised access.
- Stores must not be left unattended when open.
- Stores must only be managed by authorized persons.

DO

ALWAYS display appropriate safety and hazard signs at store entrance

- Clearly identify on a visible place that the store is used for Plant Protection Products.
- Use general warning signs, e.g display „Keep out" and „No smoking" signs on the outer door sides.

Keep instructions on hazards and emergency procedures at store entrance

- Instructions identifying all hazards and emergency procedures (e.g. telephone numbers) should be easily accessible.
- A detailed emergency plan should be kept separate from the store.

Establish emergency procedures and train your staff

- Emergency plans must show access routes to Plant Protection Product store [location]
- Emergency telephone numbers [shown on store door]
- Keep up-to-date list of products available (name, quantity).
- ALWAYS use fire resistant stores
- Check local regulations and requirements of the fire brigade.
- Walls, doors, roofs and all construction material must be fire resistant.
- Fire break walls should go up to the roof.
- One hour internal and external fire resistance is required in remote places and/or areas prone to external risks such as forest fires.
- A thirty [30] minute minimum fire resistance may be permitted where rapid response by emergency services can be expected.
- DO ensure all Plant Protection Product users are trained on emergency procedures.
- DO ensure all Plant Protection Product users have read the emergency action plans and have practised the implementation.

Ensure stores keep Plant Protection Products dry and protected from frost, excess heat and direct sunlight

- Stored Plant Protection Products must be kept dry.
- Stored Plant Protection Products must not be exposed to frost nor temperatures that exceed 40°C.
- Stored Plant Protection Products must not be exposed to direct sunlight.
- Store Plant Protection Products that containers/packages will not be damaged (e.g. by forklifts)
- The storage area should be adequately ventilated.
- Store solid products always on upper shelves, liquid products on lower shelves.

Ensure stores are bunded and/or equipped with waste collection system

- Flooring of stores must be bunded so that the total quantity of stored Plant Protection Product is completely and safely retained.
- New stores of more than 1 ton storage capacity must have a dedicated spillage holding capacity of at least 110% (185% if in water sensitive area, category „high") of the maximum stored volume of Plant Protection Product so that water used to extinguish fires or take up spills is also safely retained (check with local regulations)
- Stores of less than 1 ton storage capacity must have a dedicated spillage holding capacity of at least 10% of the maximum stored volume of Plant Protection Product or of at least the volume of the biggest container of Plant Protection Product.

Seal floors and disconnect drains

- Sealed surfaces must be impervious to liquid and solid Plant Protection Products. Seal and disconnect any drain, gully or channel in the flooring, safe the one leading to a dedicated tank to contain spillages.

Ensure floors of stores are secure, not slippery and easy to clean

- Floors must be fixed, hard and not slippery.
- Floors must be impervious to liquids.
- Floors must be smooth and without holes or depressions that could retain liquids.
- Floors must not have excessive slopes or humps that create an instability danger for containers or persons.

Use non-absorbent and easy to clean shelves

- Avoid storage surfaces with sharp points and/or edges.
- Take particular care with Plant Protection Product contained in sacks [or similar material].

Store Plant Protection Products in original packages

- Stored Plant Protection Products must be in their original containers and packaging with their labels intact and readable.

Attach to stores facilities for measuring weights and volumes of Plant Protection Products

- Stores must have appropriate and dedicated measuring facilities for Plant Protection Products attached to or within the store
- Measuring facilities must be located within a bunded area.

Store emptied containers and packages in a secured, dedicated and covered area

- Emptied, cleaned and dried containers must be stored in a dedicated area.
- Empty containers should be stored in special containers/sacks as recommended by the local container recycling/disposal service.
- Be aware that empty containers/sacks may still be contaminated with PPPs.
- The area must provide cover and restricted access.
- Keep foil seals and caps a dedicated container/sack together with empty containers (follow recommendation of local recycling/disposal service).

Repack leaking and/or damaged containers

- Plant Protection Products within leaking/damaged containers must be safely decanted into another appropriate container in good condition.
- Repacked Plant Protection Products must be immediately labelled with product name and its hazard warnings .
- Repacked Plant Protection Products should be used first , if possible, to minimise time in storage.

Equip storage rooms with facilities to safely manage spills

- Personal protective equipment [PPE] to manage spills must be available.
- Containers with absorbent inert material such as sand or sawdust, together with a floor broom, dustpan and plastic bags must be at hand.

Retain and safely dispose all spills, splashes and other losses immediately

- Be prepared for and know how to manage any spills, splashes and losses of PPP
- Check safety data sheet and/or label instructions for guidance on spill management.
- Instructions may advocate use of dry sand, cat litter (for inflammable Plant Protection Products) or sawdust to bund and absorb spills.
- Contaminated absorbent material used for spill management must be placed in sealed, labelled containers in the store to be adequately disposed (e.g. spreading in fields, add to bioremediation systems).
- Not biodegradable absorbed spills can be placed within sealed containers for incineration by specialist hazardous waste contractors.
- Keep a special place for storing obsolete stocks to have them ready for pick-up by a licensed waste operator.

DO NOT

wash Plant Protection Product spills into drains or public sewage systems

- Stores must have facilities to contain any spills, splashes, leaks and other Plant Protection Product losses.
- Stores or areas to dose the Plant Protection Product for application must be able to collect and channel all Plant Protection Product losses to a dedicated collection tank/container.
- All contents of the collection tank must be disposed either by authorised waste disposal organisations or by using approved „clean up" methods (biological, physical or chemical treatments - check with local advisers).

DO

Call emergency services if store is on or threatened by FIRE

- Immediately call emergency services if there is evidence of fire within or adjacent to the store.
- Do not attempt any damage limitation if you are not sure that this leads to success with no environmental risk. Wait until trained personnel is on site.

Take precautions to minimize flood damage

- Do assess risk with the Environment Agency.
- Consider if stored Plant Protection Products are at least 50 cm above max flood height from past 100 year period.
- Consider if store can be better located or modified to minimise flood damage risks.

BEFORE SPRAYING

Make sure that you use a sprayer that fulfils the requirements of the amendments of the machinery directive by having a CE label. If you operate an old sprayer consider upgrading the sprayer to improve environmental performance.

Pay particular attention to:

- low technical residual volumes, which remain in the sprayer after the application,
- efficient internal and external cleaning system for use in field,
- supporting technology for filling that minimises the risks of spillage and/or overflow (filler lock, flow meter).
- Make sure the operator of the application has fulfilled the required training and has a license/certification for spraying.

Planning

Spraying starts with careful planning of the application. This begins by marking the fields to be treated, the selection of the PPP and the likely weather forecast for the region at the timing of the planned application.
Adjacent waters or sources must be protected and marked. Respective buffer zones must be respected and appropriate mitigation measures need to be considered.
Be aware of adjacent sensitive areas (Water, neighbours and adjacent crops). In case of employment of spray contractors a detailed briefing is required. (See also on the internet the spray drift evaluation tool www.TOPPS-drift.org)

Plant Protection Product selection

Use only approved PPPs and study carefully the conditions for using the product. The right PPP, the right amount, the right time.

Inspection & adjustment and calibration of sprayer

Inspection of sprayers includes a third party check as required by law to have been done by the end of 2016 in EU Member States. Inspection should be in line with European Standard on inspection of sprayers (EN 13790 - 1&2). Additionally, before each application operators need to inspect the sprayer themselves on correct functioning. First, the sprayer needs to be adjusted to optimise spraying conditions. Adjustment is especially complex in Bush and Tree crops where sprayers need to be adjusted to changes in canopy structure, and multiple adjustments during a season. Adjustments concentrate on the liquid volume output rate, the spray profile and the air support (often visible spray drift is a result sprayers that are not correctly adjusted). Sprayer calibration aims at achieving a set spray application rate through the selection of the appropriate forward speed, operating pressure, nozzle type and size and needs to be calculated considering the row spacing and number of rows sprayed per passage (Bush and Tree crops)

Mixing & Loading:

Plant Protection Products have to be moved from the store, prepared for mixing and filling in the sprayer with water [in the correct sequence and quantity] and – to do so – without damaging the containers, without risk of spills, splashes or leaks. This activity is critical as it is a key source of surface water pollution with Plant Protection Products and has to be done with utmost care.

Weather forecasting:

Weather can influence the risk of Plant Protection Product losses through point sources. Rain, for example, may stop the timely use of a prepared spray solution that then has to be safely retained until it can be sprayed. It is critical to anticipate weather conditions which may stop the intended field treatment.

DO

Always plan and organize your spray activities.

- Ensure that application plans are known in detail by the operator/contractor
- Consider the implications of your Plant Protection Product use on others such as bee keepers, local residents or adjacent sensitive areas.

Identify and record the location of all environmentally sensitive zones

- Follow the recommendations for using plant protection products and be aware of environmental impacts.
- Identify and mark sensitive areas such as water bodies or other protection zones (e.g buffer zones, wells)
- Adopt strategies to protect all sensitive zones particularly noting the needs of Local Nature Reserves (LNR), Marine Nature Reserves (MNR), Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC)and Special Protection Areas (SPA).

Locate, construct and effectively cap wells

- Follow local regulations on, design and construction of wells.
- Drill new wells only where permitted.
- Drill new wells away from sites used to mix and load Plant Protection Products.
- Wells must be sealed between borehole and casing to prevent contamination. (Consider that badly sealed wells offer a direct path to the groundwater)
- Wells must protrude above ground level and be capped to prevent contamination from spray drift and runoff.

Assess whether current and predicted field conditions will allow safe and effective Plant Protection Product being used

- Avoid applications at higher wind speeds (< 5 m/s) to reduce spray drift risk.
- Avoid spray loss at high temperatures (>25 °C) or low air humidity due to potential thermal drift.
- Ensure compliance with the label for all Plant Protection Products.
- Do not spray Plant Protection Products onto frozen or snow covered ground
- Do not spray water-logged soils. (High risk for runoff).

ONLY USE approved Plant Protection Products and comply with all their Conditions of Use

- Ensure the Plant Protection Product is approved and permitted for its intended use .
- Ensure all its conditions of use are understood and can be fully implemented.
- Check relevant Safety Data Sheets.
- Check if the source of the PPP is reliable and PPP are not counterfeit.

ONLY USE approved Plant Protection Product mixes

- Check Plant Protection Product labels and follow recommendations in case of product mixtures.
- Only use adjuvant and / or additives following label/expert advice.
- Non-approved products/mixes may cause chemical/physical reactions that enhance the risk for issues such as sedimentation/blockage within equipment and need for hazardous waste disposal.
- The cleaning and removal of Plant Protection Product residues is a risk for point sources.

Ensure the sprayer operator is adequately trained and prepared for Plant Protection Product use

- Operators need to be adequately trained, tested and registered before using Plant Protection Products.
- Guidance on any training needs, certificates of competence is available from local authorities.

USE only inspected sprayers

- With the implementation of the Sustainable Use Directive for pesticides an inspection of application equipment (handheld excluded) in all Member States is necessary and needs to have been implemented by end of 2016. (Sprayer testing is cross compliance relevant).

Ensure sprayer is clean and functions correctly - especially after longer periods without use and/or being used for first time

- Make a full visual examination of sprayer for cleanliness and obvious defects.
- Check for deteriorating pipes, joints and all pressurised parts.
- Replace all suspect components.

- Check sprayer pressurising system with clear water as stated by manufacturer.

Use sprayers that allow easy adjustment and safe use

- Multi-nozzle holders make it easy to change nozzles.
- Hydraulically controlled booms reduce physical effort and the need to leave the protected cab environment to set spraying heights (e.g. 50 cm) or when folding the spray boom.
- Induction hoppers make Plant Protection Product sprayer loading safer and quicker.
- Sprayer attached hand wash facility will help keeping hands/gloves clean when working on the sprayer.

Use sprayers with spray tanks protected against accidental opening

- Lids and other spray tank closures must not allow accidental or unintentional release of any Plant Protection Product during transport and use.

Use sprayers that can be effectively cleaned in the last treated field

- Use sprayers that can be effectively rinsed internally (internal cleaning/ internal rinsing nozzles).
- Only use sprayers that retain minimal volumes of non-sprayable and non-rinseable Plant Protection Product solutions (influenced by the design of the sprayer).
- Internal rinsing performance should be capable of diluting any retained Plant Protection Product solution by a factor of 100 (i.e. down to 1 %) based on the original spray concentration.

Adjust the sprayer to crop density and canopy

Adjust the liquid volume rate needed to treat the intended plants / parts (e.g. nozzles)

Adjust the airflow rate if air support is used for the applications (low air volume in early season).

Adjust the spray profile (Tree and Bush Crops) the shape of the crop

ALWAYS verify and/or calibrate sprayer for the appropriate and optimized application of Plant Protection Products

- Calibrate the sprayer following the guidance of the manufacturer (area to be treated, application rate/ha, water volume/ha, spaying speed, nozzles types).
- Check if the volume indicator at the sprayer tank is correct (often tank scales are not precise enough (Standard allows variation of +/- 15 %).
- Use the tank scale only check if the sprayer is filled on a levelled area.
- Use a flow meter with automatic water shut-off valve to measure the exact water volume.

Calibrate and maintain sprayers in areas without risk of ground/surface water pollution

- Use areas for maintenance/calibration away from any risky spot for ground/surface water pollution.
- Calibrate on a biologically active area such as a grassed field plot.
- Leakage tests of sprayers under pressure and/or measuring nozzle outputs should be done on an biologically active area or on washing surface with a collection system for liquids.
- Keeping booms height for field crop sprayers low (max 50 cm).

Verify and calibrate sprayer with clean water

- Ensure full safety to operator, bystanders and the environment when calibrating. DO note that operators will make direct contact with surfaces such as nozzles that may have been contaminated from earlier PPP use.
- Sprayers must be calibrated before use only with water before use.
- Use water without debris and other particles such as sand that could block nozzles and filters or cause any malfunction of equipment.
- Use water volume rate(s) specified by label/guidance notes for the Plant Protection Product to be applied.

Verify and/or calibrate whenever appropriate

- Calibrate when corrosion of nozzle orifices is likely after the time of use specified by manufacturer is reached.
- Calibrate when tractor tyres have changed size (forward speed).

- Calibrate when equipment such as the sprayer's computer, pressure gauge has been changed.
- Calibrate when using a spray liquid such as liquid fertiliser whose density contrasts with that of water.
- Monitor sprayer performance whilst applying Plant Protection Product solution over the intended treatment zone.
- Good calibration helps to minimize residual volume remaining in the sprayer after application.

Do precisely calculate the total amount of Plant Protection Product and water needed

- Use data from label, calibration and intended treatment area to determine the required volumes of Plant Protection Product and water.
- Leave a small part of the field untreated in the last treated field to spray out diluted residual volume.
- DO NOT prepare more Plant Protection Product solution than required.

DO NOT

leave Plant Protection Products unattended

- Plant Protection Products must only be taken from the store [fixed or mobile] as required for immediate use only.
- Unused Plant Protection Products must not be left unattended. After filling they should be brought back to the store.

DO

Mix or load sprayers in areas that pose no risk to pollute ground or surface water

- Plant Protection Product labels may state specific or general requirements to keep a specified distance from sensitive areas.
- Check local legislation on site specific perimeters such as those that may be applicable to drinking water extraction.
- Make a risk assessment and record the details of mixing/loading sites used.
- Keep records on your filling practice
- Use bunded mixing/loading sites or use a biologically active area >20m away from surface water, wells, drains and springs.
- In addition, DO NOT mix/load over very permeable soils, shallow water tables or where runoff / erosion can be a problem.

DO NOT

fill sprayers with water directly from wells, ditches, main water supplies or any source used for drinking water

- Techniques for filling sprayers with water must be disconnected from any water source.
- Air gaps must exist between water sources supply pipes and the spray solution.
- If using water from a water source (e.g. ditch, river, pond) use an intermediate water tank as supply source (bowser/ nurse/mobile tanks) for filling sprayers to avoid any contamination risk.

allow Plant Protection Products to be a risk to contaminate ground/surface water when loading

- DO NOT overfill or let foam escape from the spray tank.
- DO note that filling times of smaller tanks - such as those on knapsacks – may be very short.
- Do not fill up the spray tank completely. Respect the over volume to ensure excess capacity [typically a further 10%]. This minimises the risk of spills, overflow and foam escape.
- DO NOT use rinsing tank or other containers on sprayers for Plant Protection Product use.
- DO remove any Plant Protection Product spills on hard surface immediately.

DO

Prepare Plant Protection Product solutions just before to their use

- Safety of Plant Protection Product use is increased when delays between mixing/loading and spraying are minimal.
- Avoid preparing Plant Protection Product solutions if there is risk of delays due to nightfall, weather or difficulties with sprayer, etc.

Plan the requirement of Plant Protection Products as precisely as possible

- Plan the requirement of Plant Protection Product to minimise the amount of opened packs.
- Use Plant Protection Product containers, such as those with 45 or 63 mm wide openings that pour easily and without splashes.
- Use containers that freely drain all their contents and that are easy to clean.

DO NOT

damage containers/packaging when opening

- Use dedicated knifes to carefully open bags and boxes to avoid any uncontrolled release of Plant Protection Products.
- Use special cap and seal removers.

DO

load Plant Protection Products for dilution according to instructions

- Follow Plant Protection Product label advice.
- Typically, Plant Protection Products must never be loaded into an empty spray tank.
- Load when main tank is at least half filled with water.
- Seek guidance when mixing individual Plant Protection Products and/or using water volumes beyond that advised.
- Seek guidance when mixing contrasting formulations. If no advice is available then consider the following sequence: water soluble bags, water dispersible granules, wettable (soluble) powders, suspension concentrates, emulsifiable concentrates and adjuvants.
- Follow any specific guidance for the loading of Water-Dispersible Granules (WG), powders and water soluble sachets.

Use dedicated measuring equipment

- Measuring equipment must be labelled for its exclusive use.
- Measuring equipment must be safely rinsed / cleaned immediately after use.

DO load/mix Plant Protection Products from a stable and safe operating position

- Operators must not climb or excessively stretch while moving to load PPPs.
- Loading position must be within arm's reach and at waist height of operator.
- Raised working platforms must be safe, not slippery and not liquid-retaining as well as being easily cleaned (max filling height 130 cm).

DO avoid operator/bystander exposure

- Use the appropriate personal protective equipment advised on Plant Protection Product label or with its supporting literature.
- Avoid loading (especially powders) when wind could move Plant Protection Product particles to operators or bystanders.

DO load and clean Plant Protection Product containers with integrated / attached sprayer equipment (induction hopper).

- Use low level induction hopper with integrated container rinse facility.
- Plant Protection Product labels may detail specific requirements to load/clean for example, larger pack sizes.
- Always load Plant Protection Products into induction hoppers such that there is no risk of spill or splash or undue equipment contamination.
- Visually verify cleaning performance of the tank/induction bowl in use.
- Check Plant Protection Product label to see if rinsing procedures are specified.
- Integrated pressure washers must be capable of rinsing the empty container at a dilution of $< 0.1\%$.
- Manual rinsing of empty Plant Protection Product containers must include a minimal triple rinse procedure [1/3 of container to fill with clear water, close and shake intensely, rinse water into the spray tank / induction hopper]. This procedure needs to be executed 3 times (Triple rinse).

Clean and safely manage seals and caps

- Check with waste collecting company for guidance on collection and disposal of seals and caps.

Seal and secure partly used containers/packages immediately after use

- Replace seals securely immediately after use.
- Partly used containers must be returned to the store, kept upright, stable and secure to avoid leaks, spills and unauthorised use.

DO NOT

leave sprayers unattended during filling

- Always supervise the sprayer when loading with Plant Protection Products.
- Be prepared to take emergency actions.
- Keep unauthorized persons away.
- Position the sprayer and its contents within a secured bunded area during any unexpected longer term delay.


HARDI

DURING SPRAYING

In general point source pollution is linked to activities on the farmyard. Point source entries can also occur by direct contamination, e.g. spraying directly on water courses or surfaces, insufficient protected wells/springs, spraying on hard surfaces (access roads).
Operators need to be prepared to deal with emergencies in case of accidents (mobile with important phone numbers, vehicle tool kit) and avoid direct contamination of water and roads.

Transfer from diffuse sources (applications in field) occur by a number of routes,e.g. runoff/erosion, spray and dust drift, leaching and drainage (see TOPPS BMPs) to reduce transfer from these sources.

DO

only spray while driving

- DO NOT spray when sprayer is stationary.
- Only start spraying when the sprayer is moving at calibrated speed.
- Consider the use of spray booms that can re-circulate spray liquid and that can deliver the correct dose from the beginning of application.

Use technical solutions to avoid overlaps during spraying in the field and to reduce drift

- Use sprayers with section switches on the sprayer to adapt spray swath to non-rectangular field shapes and to reduce overlaps.
- Use field practices that minimise boom movements.
- Ensure boom height is as required by manufacturer; typically 40 to 50 cm for fan nozzles above first intercepting foliage (greater height = greater risk of drift).

Rectify/adjust any equipment problem at once

- Stop spraying and depressurise system in case of problems.
- In case of needed repair mark field location where the spraying was interrupted.
- Avoid buffer zones or environmentally sensitive areas or public roads to conduct any necessary repairs on the sprayer.
- Wear personal protective equipment and be prepared to contain Plant Protection Product spills.

Have plans and be prepared for any emergency

- Let your staff know where you are spraying and how long you are expected to be busy.
- Have mobile telephone with emergency contact numbers ready at hand.
- Take care when folding/unfolding wider booms in the vicinity of e.g. power cables masts / trees.
- Be aware of the hazards when turning on inclined fields.
- Take special care with partly loaded sprayers when turning, slowing down or speeding up to reduce the risk of overturning.
- Take care when folding/unfolding booms in vicinity of people.

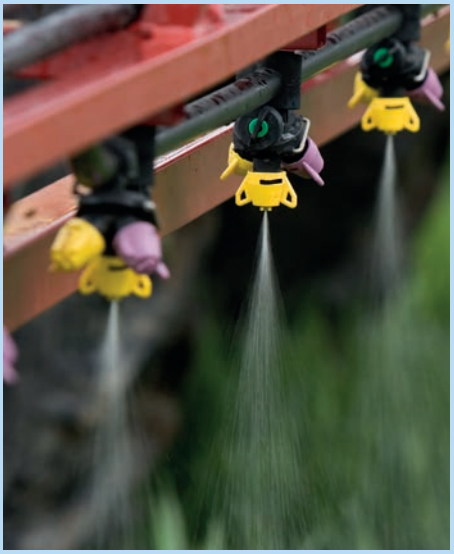
DO NOT

over spray buffer zones or any environmentally sensitive areas, watercourses, wells, drains, springs, public rights of way and hard surfaces

- Spray headlands last and take particular care [or do not spray] when wind blows towards adjacent sensitive zones.
- Adjust the spraying swath to match the required treatment width – especially areas adjacent to headlands.
- Turn off boom sections of sprayer and/or individual nozzles to avoid overlapping applications.
- DO not treat buffer zones and/or any non-spray areas around wells.
- Respect buffer zones.
- Use drift reducing nozzles along sensitive areas and do not drive faster than 8 km/h.
- Consider wind direction and speed, when spraying in the vicinity of any sensitive areas. (Use TOPPS drift evaluation tool www.TOPPS-drift.org)


OPTIMUM


RAU

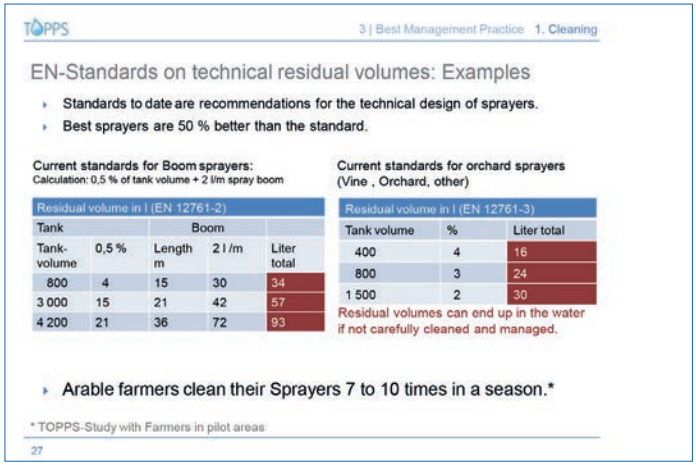


AFTER SPRAYING

The careful cleaning of spray equipment in the last treated field is one of the most important activities to minimise the risk of point source pollution. In general, as little as possible diluted Plant Protection Product/liquid should return to the farmyard.

Advice given in different European Member States varies considerably. To date, due to technical limitations, sprayers cannot be completely emptied. Even if air comes out of the nozzles some residual liquid remains in the sprayer. These technical residual volumes must be diluted as much as possible and sprayed out in the last treated field.
Technical requirements for sprayer cleaning in the field are having (i) clear water for rinsing, (ii) an efficient internal cleaning system and (iii) an attached spray lance for external cleaning (especially important for Bush and Tree sprayers).

Why is correct rinsing /cleaning in the field so important?
Standard requirement for sprayers concerning the technical residual volume: EN 12761 -2,3 (need to check number)


TOPPS 3 | Best Management Practice 1. Cleaning

EN-Standards on technical residual volumes: Examples

- Standards to date are recommendations for the technical design of sprayers.
- Best sprayers are 50 % better than the standard.

Current standards for Boom sprayers:
Calculation: 0,5 % of tank volume + 2 l/m spray boom

Residual volume in l (EN 12761-2)				
Tank		Boom		
Tank-volume	0,5 %	Length m	2 l /m	Liter total
800	4	15	30	34
3 000	15	21	42	57
4 200	21	36	72	93

Current standards for orchard sprayers (Vine , Orchard, other)

Residual volume in l (EN 12761-3)		
Tank volume	%	Liter total
400	4	16
800	3	24
1 500	2	30

Residual volumes can end up in the water if not carefully cleaned and managed.

- Arable farmers clean their Sprayers 7 to 10 times in a season.*

* TOPPS-Study with Farmers in pilot areas

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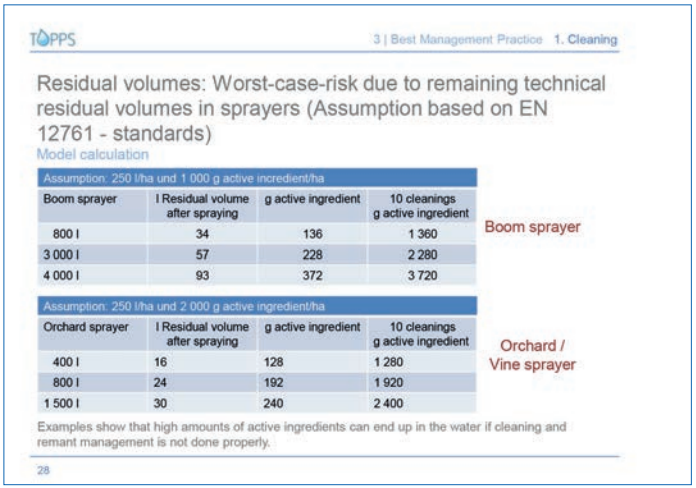
What could it mean if the residual volume returns to the farmyard completely without rinsing in the field?


TOPPS 3 | Best Management Practice 1. Cleaning

Residual volumes: Worst-case-risk due to remaining technical residual volumes in sprayers (Assumption based on EN 12761 - standards)
Model calculation

Assumption: 250 l/ha und 1 000 g active incredient/ha

Boom sprayer	l Residual volume after spraying	g active ingredient	10 cleanings g active ingredient
800 l	34	136	1 360
3 000 l	57	228	2 280
4 000 l	93	372	3 720

Boom sprayer

Assumption: 250 l/ha und 2 000 g active ingredient/ha

Orchard sprayer	l Residual volume after spraying	g active ingredient	10 cleanings g active ingredient
400 l	16	128	1 280
800 l	24	192	1 920
1 500 l	30	240	2 400

Orchard / Vine sprayer

Examples show that high amounts of active ingredients can end up in the water if cleaning and remant management is not done properly.

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INTERNAL RINSING OF SPRAYERS

a) Field crop sprayers

The current standard (EN 12761) defines the allowable technical residual volume in sprayers according to the formula: 0.5% tank volume + 2 l / m boom width (Example: Sprayer 1000 l tank and 20 m boom length = (0,5% from 1000l) 5 l + (20m boom x 2l) 40 l = 45 l Residual Volume.) This formula can be taken as a rule of thumb for estimating the technical residual quantity, although by optimized design some modern sprayers can reduce the technical residual volume by 50% and hence the risk of point sources is already reduced significantly. Farmers should know the performance (dilution factor) of the sprayer cleaning system). The technical residual volume assumes well calibrated sprayers and spray solution calculated without a reserve. It is not always easy to exactly calculate the spray solution needed especially if irregularly shaped fields need to be sprayed. The last field to be sprayed therefore should be the one which has a regular/ rectangular shape.

Research showed that correct sprayer cleaning in the field could reduce point sources by about 70 % (Univ. Giessen). Technical residual volume remain a challenge for water protection as it is expected that many sprayers, which are not equipped with a rinse water tank, are still in use, as well as larger sprayers with higher residual volumes in their hydraulic networks.

b) Air assisted sprayers

Residual volumes remaining in air assisted sprayers after application are lower compared to field crop sprayers as less volume is taken by supply lines and booms. In Bush and Tree crops generally higher concentrations of PPPs are applied, therefore the residual volumes need to be treated with the same care as for field crop sprayers. Especially important for air assisted sprayers are Plant Protection Products deposits at the outside of the sprayer due to the turbulence from the air support.

There are three basic methods for internal rinsing of the sprayer

a) Manually operated (3 step rinsing)
b) Continuous rinsing
c) Automated rinsing

a) Manual 3 step rinsing

With the three-step rinsing method clear water is filled 3 times into the main spray tank (3 x 1/3 of from the clean water tank) Water is either introduced by gravity (no direct connection to an internal cleaning device) or is delivered via the sprayer pump through an internal rinsing device (e.g. rotary nozzle) in order to clean PPP deposits and to reach also less accessible areas in the spray tank. The water is mixed with the residual volume (dilution) and after each cleaning/rinsing the diluted residual volume is applied on the last treated field. The three-step rinsing method is manually performed, which means that after each rinsing step the operator needs to step down from the tractor. The three step rinsing is necessary to reach dilution factors of 50 to 100. Yet this process is time consuming not very convenient and can take about 30 min.

b) Continuous rinsing method

With the continuous rinsing method, a separate pump fills clear water into the spray tank via cleaning nozzles. The regular sprayer pump then presses the rinsing water out through the regular sprayer pipe network. The separate pump should provide about 90% of the nozzle output, so that no spray mixture flows back into the tank via the return circuit. Depending on the sprayer a valve to stop the return flow to the main tank is recommended for best results.

The advantage of the method is that the residual volume is quickly and continuously diluted. The operation is performed from the tractor cabin and stepping down from the tractor is not required. (Faster and more comfortable). Older sprayers can be retro-fitted with a clear water tank, internal rinsing nozzles, extra pump and the necessary hoses and valves. For smaller sprayers, a separate electric clear water pump is sufficient, for larger sprayers hydraulic pumps are available. (e.g Agrotop, Aams-Salvarani, Herbst). Some manufacturers already offer continuous rinsing technology with new sprayers.

c) Automated rinsing

Newer and larger sprayers offer automatic rinsing systems, which steer the procedure either through continuous rinsing systems or through multiple step rinsing procedures. Variations in the performance of the rinsing systems vary strongly among sprayers and it is recommended to check the rinsing performance in detail when purchasing a new sprayer.

EXTERNAL CLEANING

a) Field Crop Sprayer

Spray residues can accumulate on the outer surfaces of the sprayer and tractor.
The largest amounts of PPP deposits are found in the vicinity of the boom and nozzles. Deposits are higher if fine droplets are sprayed. Small droplets are swirled while driving and deposited in the central area of the boom and in the rear area of the tank. Also, the front portion of the sprayer can be contaminated during turning. We also can assume that deposits of PPP are higher when using air support devices.

b) Bush & Tree Crop sprayers (BTC)

- BTC sprayers use air support to transport droplets to the target. Deposits on BTC sprayers are generally much higher compared to field crop sprayers due to higher turbulence. Research data from Belgium show that the deposits can vary between 82,5 and 207 g active ingredients on the sprayer outside in one spray season (Debaer et al. 2008). In Italy outside contamination of orchard sprayers was measured at between 0,33 to 0,83 % of the amount applied per application (Balsari et al. 2006).

- The air support system and the sprayer adjustment strongly influence the PPP deposits on the sprayer
  It has been shown that cleaning the outside directly after spraying is more effective and consumes less water compared to cleaning later when spray deposits are dry.

The cleaning should, if possible, take place in or nearby the field that was last treated. In case of dried Plant Protection Product residues on the outside, the clean water for cleaning may not be enough. In this case it is recommended to fill the spray tank with clear water on farm (after cleaning the inside) and do the external cleaning on an area where washing water can be collected or in the last treated field. Sprayer manufacturers offer accessories for external cleaning (High and low pressure pumps with appropriate spray lances).


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HANDLE REMNANT SOLUTIONS OF PLANT PROTECTION PRODUCTS CORRECTLY

- Sufficiently diluted spray mixtures can be applied on the last treated field. A small untreated part of the surface can be used to spray out the diluted technical residual volume
- If e.g. due to weather conditions, the spraying has to be interrupted, find out how long the spray mixture is stable or can be applied, without causing sedimentation or clogging filters and pipes.
- Sprayers containing spray liquid have to be parked in a safe and protected place.
- Excess amounts of spray liquid can be stored for a short time in labelled, secure containers (for safety instructions check with the manufacturer/adviser).

DO NOT

release undiluted spray liquid to the ground

- Collect residual quantities for further treatment if incurred on farm. Recommendations in the countries are very different. Example: Treatment of residues in a biobed/ biofilter, diluted amounts of residue can remain in field/ be distributed if the spray mixture is diluted to 1-2%, collect in slurry.

Never clean sprayers near surface water

- Clean sprayers only in areas with no connection to sewage, groundwater or surface water.
- Clean the sprayer on biologically active surfaces or on a secure washing place (collection of contaminated liquids)

DO

clean sprayers

- Insufficient internal cleaning incurs the risk of subsequent crop damage or unwanted crop residues.
- Clean the sprayer on the inside and outside to reduce the risk of water contamination through point sources.
- Clean the sprayers to reduce the risk of contamination, when for instance servicing the sprayer.
- Follow the instructions of the consultant/supplier regarding the use of any cleansing agents.
- Use high-pressure devices and/or recommended equipment for the external cleaning of the sprayer. It must be ensured that contaminated washing water cannot reach water bodies.

DO store sprayers in safe places

- Sprayers that are not used must be securely parked.
- Store cleaned sprayers covered, protected from rain and frost damage.

DO ensure sprayer is well maintained

- Maintain sprayer regularly.
- If possible, undiluted or diluted Plant Protection Products should not be retained within the sprayer.
- Maintenance activities should be done carefully to avoid any contaminations.
- Depending on sprayer design spray liquid can leak when maintaining sprayer e.g opening of filters. Spills should be avoided and immediately contained.
- For maintenance work use protective clothing.
- DO not make internal repairs in tanks as this is a specialist task often done under special safty precautions.

WASTE AND REMNANT MANAGEMENT

If measures are taken as recommended above very little contaminated liquid returns to the farmyard after spraying. For remnants mainly from filling and cleaning of sprayers, cleaning pesticide containers/packaging and maintenance work are critical. Washing should never be done on a hard surface which cannot collect potentially contaminated water. Further PPP waste may arise from products that are no longer approved for use. The disposal of this waste must be done by specialized companies.
Information on how to deal with them can be obtained from plant protection products manufacturers, suppliers or local authorities.
The findings of PPP in surface water demonstrate that a large amount originates from operations in the farmyard. We therefore must assume that the awareness of some operators is low and BMPs are not carefully followed. It may be more convenient to clean sprayers on the farmyard compared to cleaning it in field. Also, older spray equipment is not sufficiently equipped to fully execute the BMPs (e.g. no freshwater tank). In addition, recommendations on how to deal with remnants do not exist in some countries, and where they exist, they are not consistent between countries.

Treatment of remnants

Biological method (biodegradation)
In several EU countries (UK, France, Belgium, Sweden) biological methods are approved to treat remnants (biobed, biofilter). Biofilters/Biobeds/Phytobac and other systems work on the principle of microbiological degradation of PPPs in a bioactive matrix. The biofilter/biobed is filled with organic materials and is inoculated with microorganisms from previously treated soils. Contaminated liquids are applied onto these organic materials and percolate through the organic material. Fresh organic material (e.g. straw, peat) needs to be added to the biofilter/biobed every year and it needs to be replaced completely after 6 to 7 years of use. Typically, in biofilters/biobeds a significant part applied of water to be treated is evaporated and this can be further optimized e.g. in combination of plants (additional transpiration losses) so that no water will exit the system. Further information can be found on the TOPPS website: www.TOPPS-life.org/Remnant Management/Bio-purification brochure.
Biological methods have their limitations when microbial degradation is not working properly, e.g due to the presence of copper or sulphur. In some countries /regions the disposal of remnants into the slurry is recommended while this is forbidden in others. Please check local recommendations.

Physical /chemical methods

In some countries, mobile cleaning systems are used. These work on the basis of absorbing PPP residues with activated carbon. The carbon has to be treated as hazardous waste if it has lost its absorbing capacity. Additional chemicals are used to improve the cleaning effect.

Physical methods

Contaminated liquids are collected in a protected basin in order to separate the PPPs in the remants from water by evaporation, e.g. Heliosec, or by Osmofilm. Such systems are protected against outside influences such as rainfall and preventing bystanders or wildlife from damaging the construction. The remaining dry residue is collected and disposed of as hazardous waste and incinerated.

Minimise the amount of remnants

- Plan and organise all the work in advance.
- Buy and store only Plant Protection Products that you actually need.
- Calculate how much PPP you need for spraying operations accurately and use a calibrated sprayer.
- Clean/rinse your sprayer carefully in the field if possible also from the outside.
- Use a sprayer with low technical residual volume and an effective rinsing system. (Differences can be important).
- Clean the pesticide containers carefully (triple rinsing/ cleaning nozzle)

Follow the instructions for disposal of PPP containers/package

- Use disposal service of empty Plant Protection Product containers and packages.
- Keep empty Plant Protection Product containers/packages in securely closed areas and make sure that no residual liquid leaks.
- Never burn or bury Plant Protection Products, their containers and/or packaging.

Store safely Plant Protection Products that are obsolete

- Obsolete Plant Protection Products to be stored in dedicated place and to be labelled as such.
- Find out about national legislation concerning disposal of products that are no longer authorized.

Dispose obsolete Plant Protection Products by an authorized waste collection company

- Arrange for the obsolete PPP collection by supplier or authorised waste disposal contractor.
- Plant Protection Product for collection must be in their original containers and packaging with intact labels.
- In case you do not need a specific Plant Protection Product as planned bring the unused product back to the retailer / distributor.

Do collect diluted Plant Protection Product residues and follow local regulations/recommendations

- Always make sure that diluted pesticides do not enter surface or ground water via waste water or through any other route.
- Low risk of water pollution arises if the diluted residual PPP quantities are sprayed in field or treated by appropriate remnant treatment methods.
- Because local regulations/recommendations are so different specific recommendations at this point are not possible. Please enquire with competent authorities for the local situation.

Follow the regulations for the use of Plant Protection Products

- Check whether products are authorized for use.
- Keep a list of the stored products.
- Products which are no longer authorised for use must be removed and stored in a safe, legal way.

Follow the instructions for disposal of packaging and content for Plant Protection Products

- Follow the requirements and use collected disposal of Plant Protection Product containers and packages when available (country specific).
- Keep empty Plant Protection Product containers / packages in securely closed and covered areas and make sure that no residual liquid may leak.
- Do never burn or bury Plant Protection Products, their container and/or packaging.


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