Nestlé
Good Food, Good Life

Minimizing the risk of microbial contamination in primary production of berries

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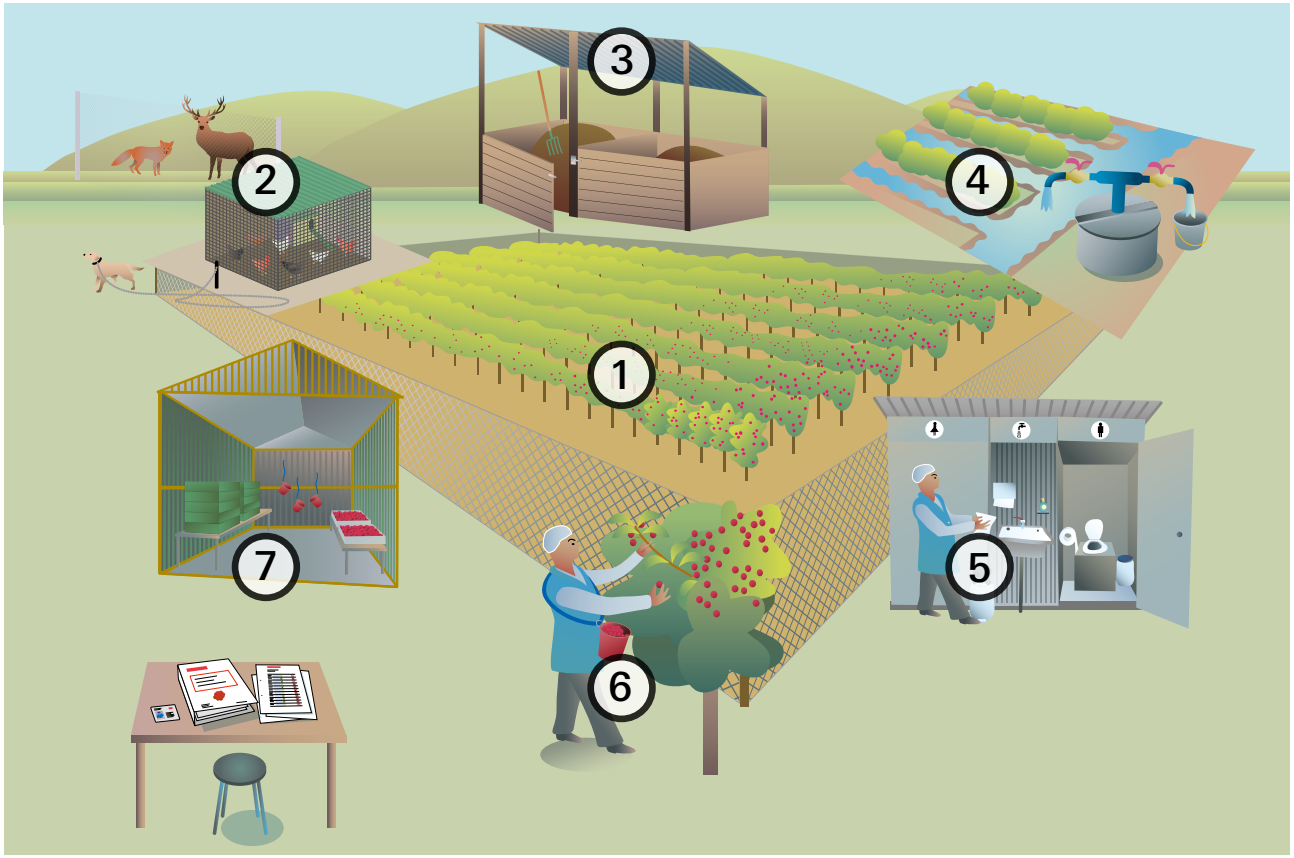
The seven routes of microbial contamination in primary production of berries



In the recent past, fresh and frozen berries, grown in different regions of the world, were found to be contaminated with pathogenic bacteria such as *Escherichia coli (E.coli)* O157 or human viruses such as Hepatitis A or Norovirus. Consumers became sick from eating these berries, some even died.

Contamination can occur at different stages of the berry supply chain, particularly during primary production and harvesting. Therefore, it is very important to minimize the risk of microbial contamination at farm level.

Where does the contamination at farm level come from? Contamination can have several origins, these are the so-called "routes of microbial contamination". Seven routes have been identified, which are represented in the above illustration:

1. Growing field and adjacent land;
2. Animals;
3. Manure-based soil amendments;
4. Agricultural water;
5. Hygiene and human health;
6. Worker harvesting practices;
7. Harvesting equipment, storage areas and transportation.

(Continuation page 2)

Some of your activities are also important to record and/or should be supported by documents.

This training booklet comprises seven chapters, one per route of microbial contamination. Each chapter indicates good agricultural practices to follow during farm activities in order to minimize the risk of microbial contamination posed by this particular route. By following these practices, you will improve the safety of the berries you are growing and the safety of the people who are consuming them, as well as the health of your workers.

This document refers to the Nestlé Supplier Code and the Responsible Sourcing Guidelines. It is meant to go beyond compliance, supporting farmers and suppliers (berries purchasers) in continuous improvement and development.

The primary target audience is:
– Farmers
– Farm workers (e.g. hand pickers, supervisory personnel in the field…)
– Berries purchasers

Contents

Symbols

The following symbols will be used to guide the reader through the document

Detergent

Disinfectant/ sanitizer

Hand soap

Hand disinfectant

Do/Don't do

Worker

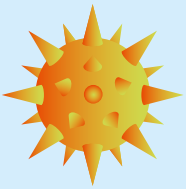
Farmer

Competent super-visory personnel

Competent professional

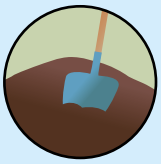
Berries purchaser

Pathogenic Bacteria



Pathogenic Viruses

Raw manure



Treated manure

Hand washing

Pesticides dilution

Cleaning

Training

Symbols

The following symbols will be used to guide the reader through the document

Potable water

Harvested rain water

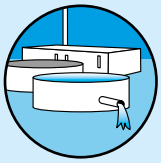
Irrigation

Non potable water

Municipal water

Drip irrigation

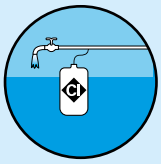
Surface water



Secondary treated sewage water

Furrow irrigation

Ground water



Disinfected water

Overhead irrigation

Flood irrigation

Definitions

Crop production area:
A plot of land where all growing and harvesting activities of berries are performed, including the growing field, storage areas, toilet and hand washing facilities.

Growing field:
A plot of land used to grow berries.

Storage area:
A facility/contained area inside the crop production area, used to store harvesting containers before use and/or harvested berries before their transportation to the processing plant (no more than 12 hours of storage for berries).

Agricultural water:
Water used for agricultural activities in the crop production area, such as: irrigation, pesticide dilution, cleaning of equipment and hand washing.

Potable water:
Water that meets the microbial standard for drinking water from World Health Organization (*E. coli* must not be detectable in any 100 mL sample).

Non potable water:
Water that does not meet the microbial standard for drinking water from World Health Organization.

Municipal water:
Potable water provided by the municipality.

Primary treated sewage water:
Sewage water treated with a primary treatment. A primary treatment aims to reduce any settleable solid within the sewage water via mechanical treatment (filtration and sedimentation).

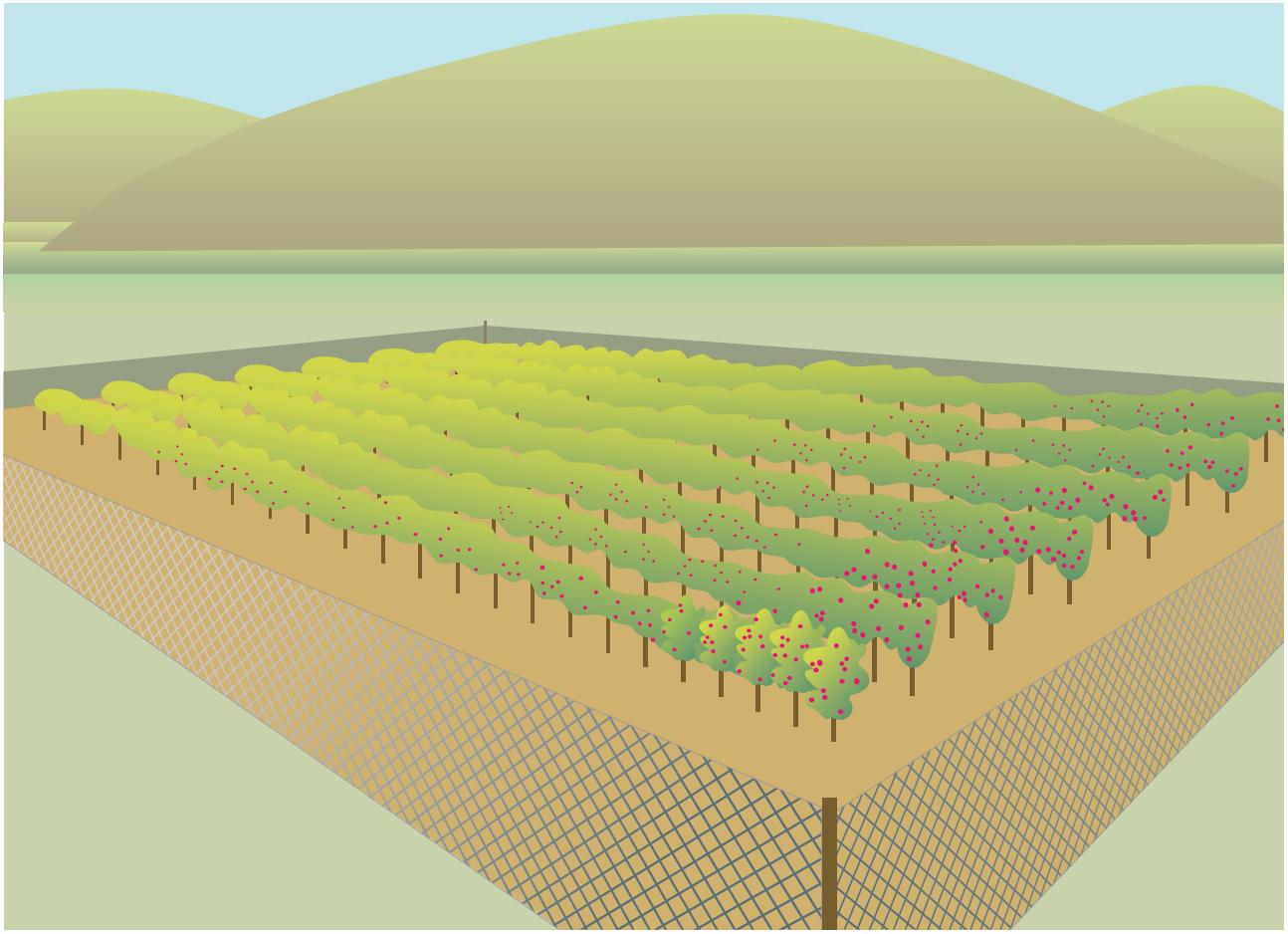
Secondary treated sewage water:
Sewage water treated with primary and secondary treatment. Secondary treatment aims to decompose remaining suspended solids from the primary treated sewage water and to greatly reduce the microbial load via biological treatment (e.g. stabilization ponds).

Disinfected water:
Water treated (e.g. chlorination) to remove pathogenic microorganisms such as *Salmonella* and viruses. Secondary treated sewage water can be disinfected to remove remaining pathogenic microorganisms that were not removed by previous treatments.

Turned pile/windrow composting:
Process to produce stabilized compost in which air is introduced into a manure pile or windrow by turning on a regular basis. Turning is performed with the specific intention of moving the outer, cooler sections of the manure being composted to the inner, hotter sections.

Static aerated composting:
Process to produce stabilized compost in which air is introduced into manure by a mechanism that does not include turning.

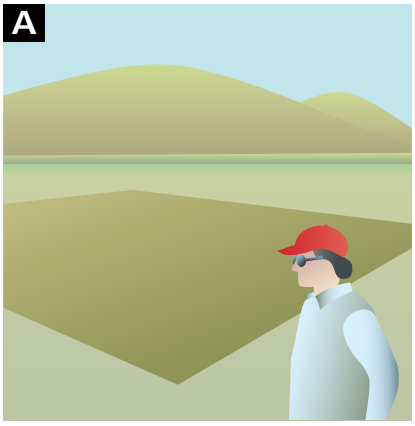
1. Growing field and adjacent land

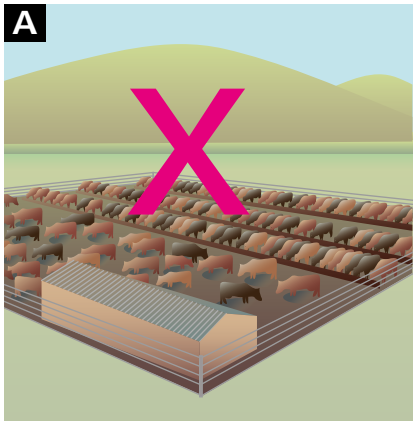


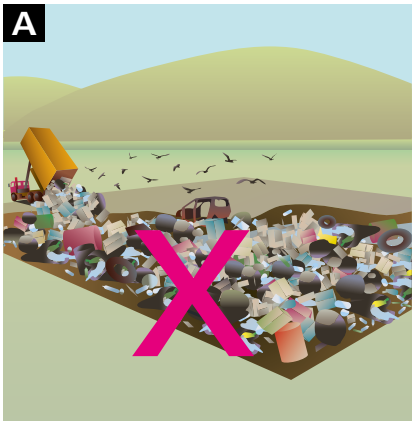
Previous land use (land and adjacent land): Pathogens in the soil

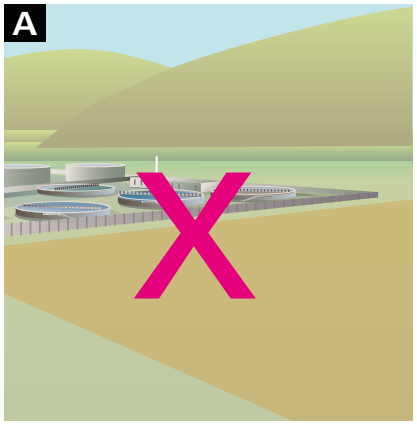
A **Previous land use (land and adjacent land) should minimize the risk of microbial contamination of the soil: avoid use of land that may have been contaminated by microbial hazards, especially fecal contamination and contamination by organic waste (e.g. animal production site, municipal waste/sewage disposal or treatment sites…).**

Select fields carefully to reduce the risk of microbial contamination.

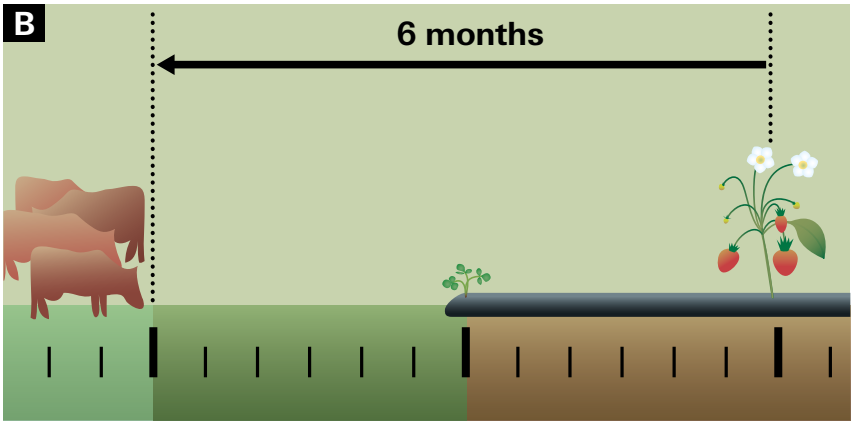








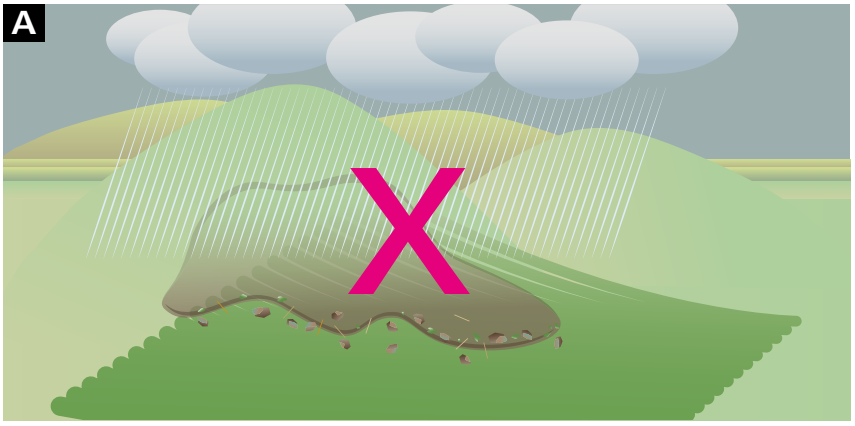
B **If livestock has been grazing in the field, ensure a time lapse between livestock grazing in the field and harvest of minimum six months.**



C **Irrespective of previous land use, protect the crop from the soil whenever possible (e.g. plastic coverage or straw on soil for strawberries).**

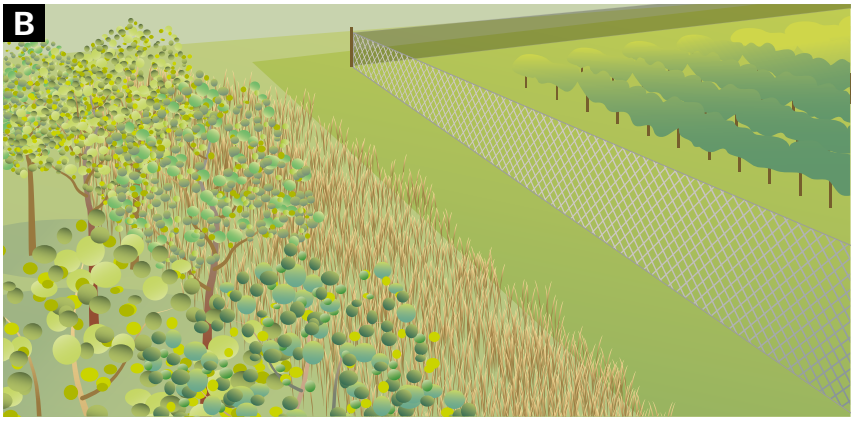
Water and/or soil run-off

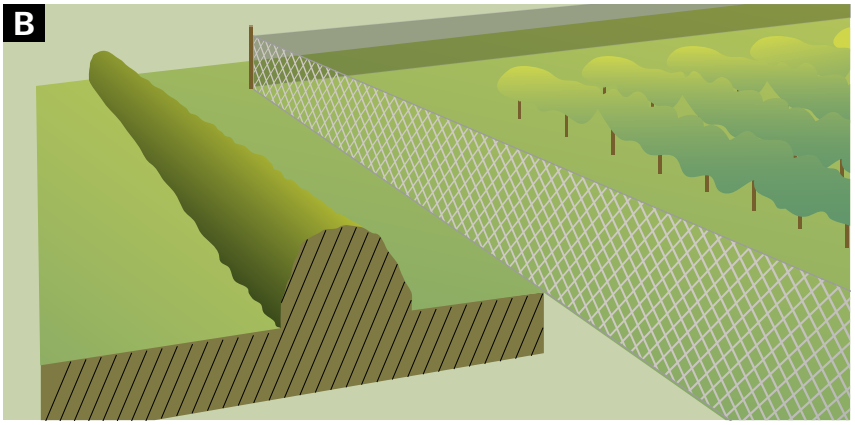
A **Avoid using land which may be subject to water and/or soil run-off from higher land/or neighbouring land.**

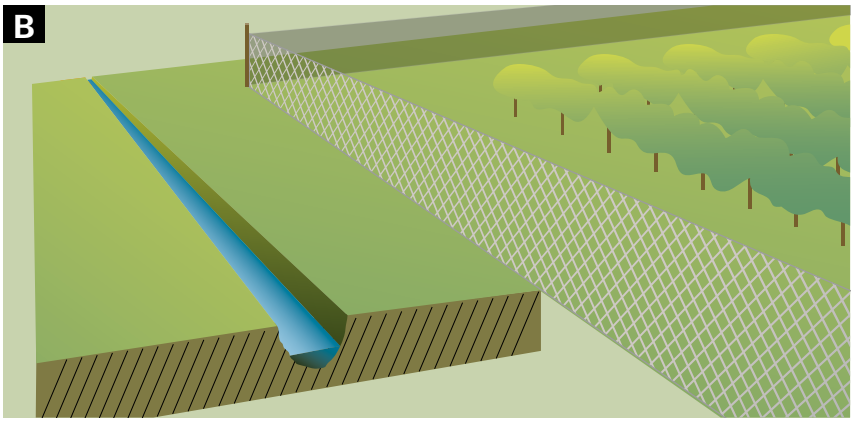


B **If water and/or soil run-off can occur, implement physical barriers between higher/neighbouring land and the crop production area such as:**

- **vegetative buffer areas e.g. grass land, trees or another crop production which is not sensitive to microbial contamination;**
- **mounds;**
- **ditches.**





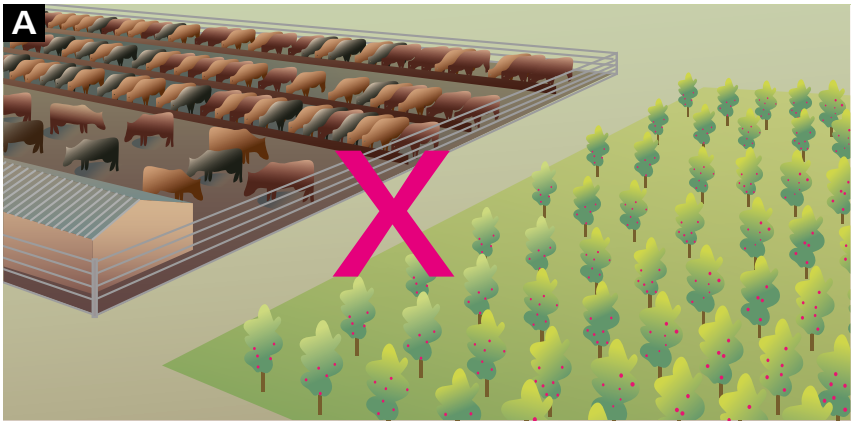


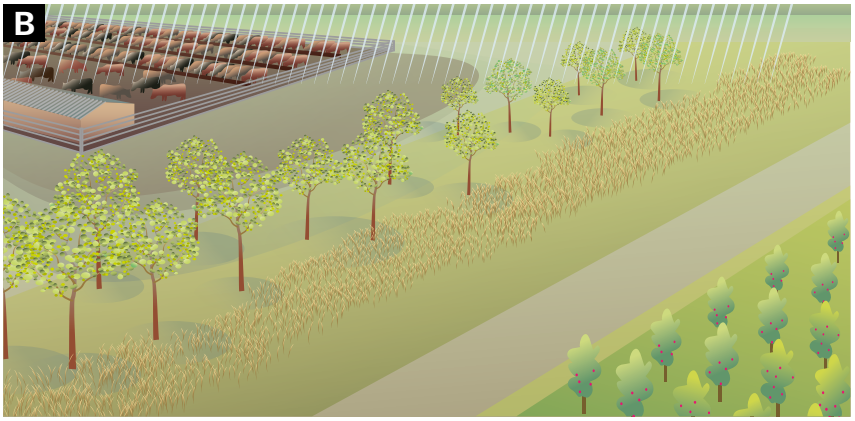
Adjacent land use: Livestock production facilities (cattle, poultry, pigs…)

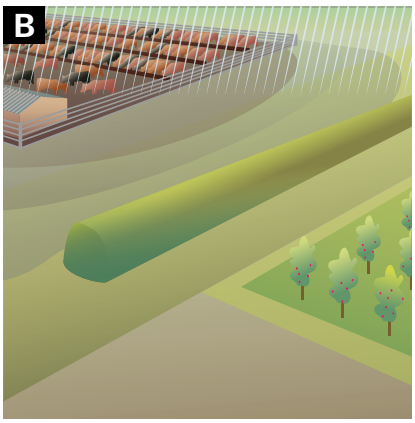
A **Avoid the use of land adjacent to animal production facilities.**

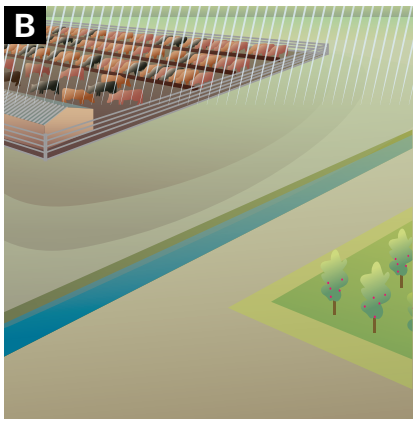
It is reasonable to assume that increasing distance will help to reduce the risk, although distance by itself is not a guarantee of no risk.

B **If there is a risk of animal waste contamination from land in the vicinity of the crop area (e.g. during heavy rains), implement physical barriers between adjacent land and the crop production area such as described in section B of "Water and/or soil run-off", page 10.**



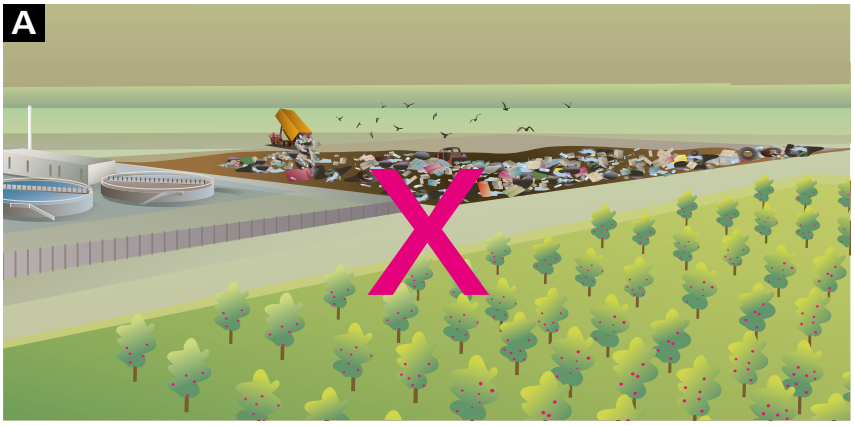




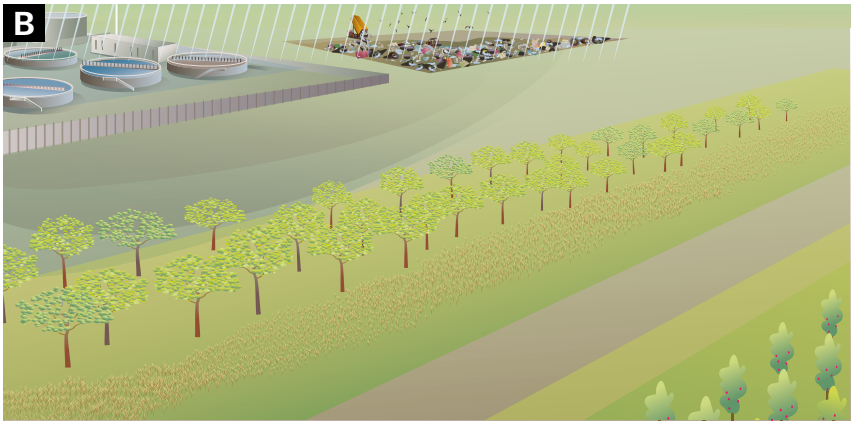


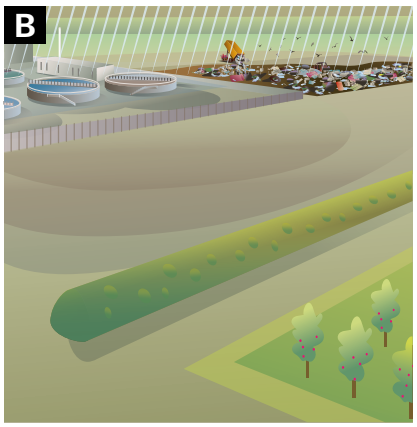
Adjacent land use: Industrial and urban activities

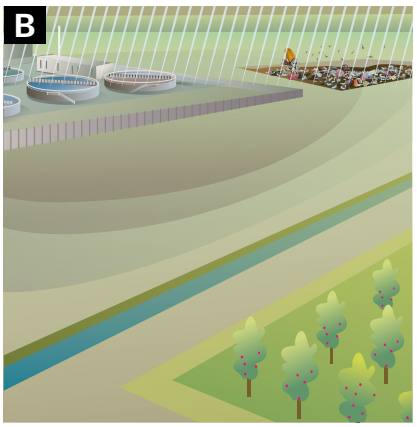
A **Avoid the use of land adjacent to industrial and/or urban activities such as sewage treatment or municipal waste collection.**



B **If there is a risk of industrial and/or urban waste contamination from land in the vicinity of the crop area (e.g. according to the slope of adjacent land), implement physical barriers between adjacent land and the crop production areas such as described in section B of "Water and/or soil run-off", page 10.**

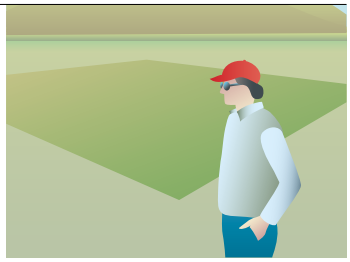




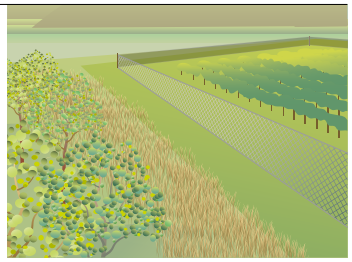


Growing field and adjacent land: REMEMBER!

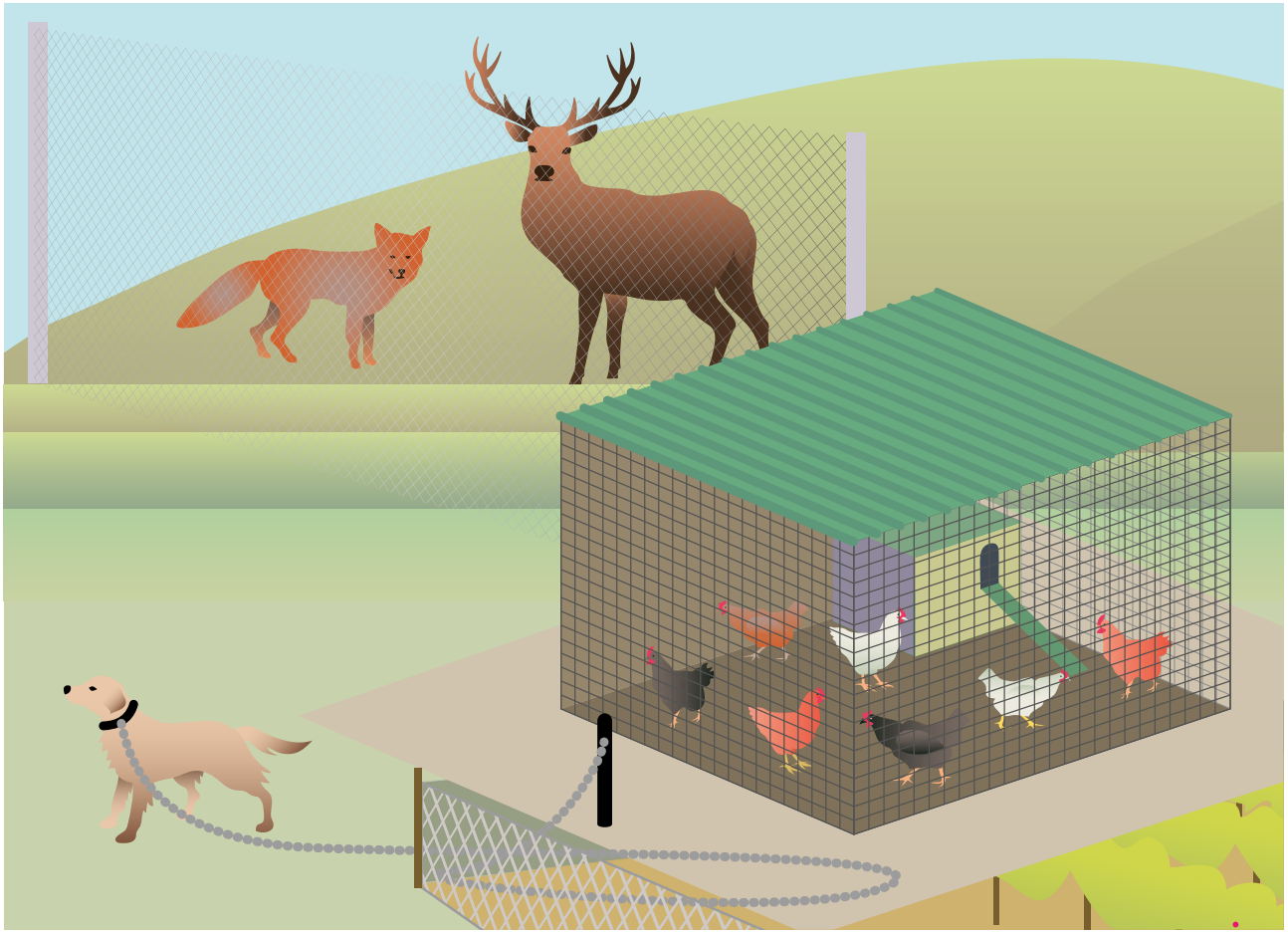
1. Select fields carefully to reduce the risk of microbial contamination.



2. If there is a risk of contamination from land in the vicinity of the crop production area (e.g. during heavy rains), implement physical (vegetative) barriers.



2. Animals (domestic, farm and wild animals)

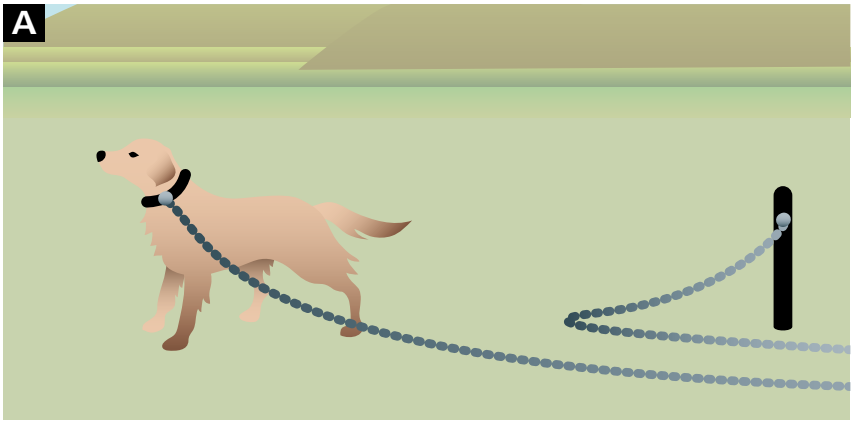


Domestic animals (dogs, cats…)

A **Limit access of domestic animals to growing fields and storage areas during the growing season and during harvesting: their movements on the farm should be controlled and their fecal waste discarded outside the crop production area (e.g. burried).**

B **Inform all workers that they are not allowed to bring animals onto the crop production area. Consider the use of signs to inform workers (e.g. as part of the general restrictions in the crop production area).**

A



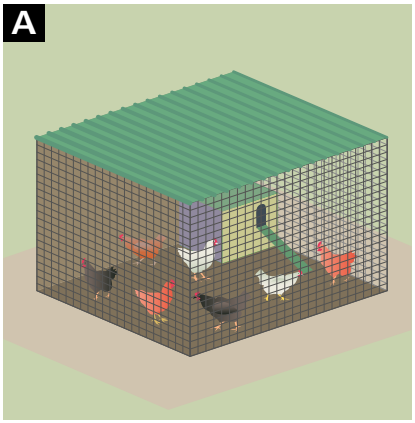
B

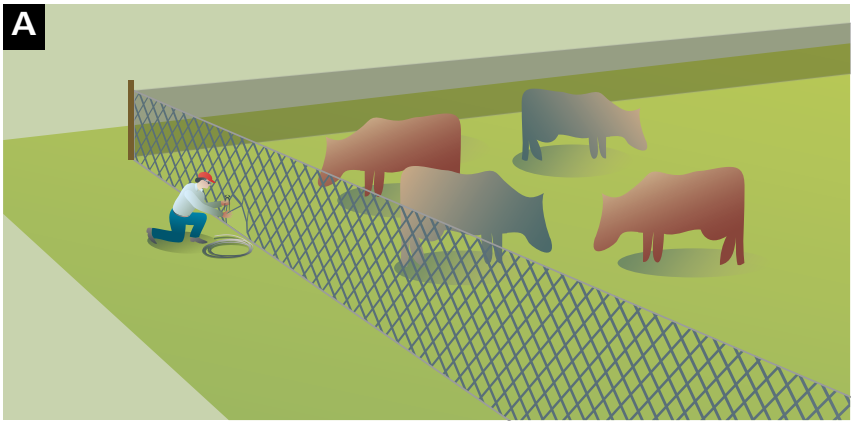
B

B

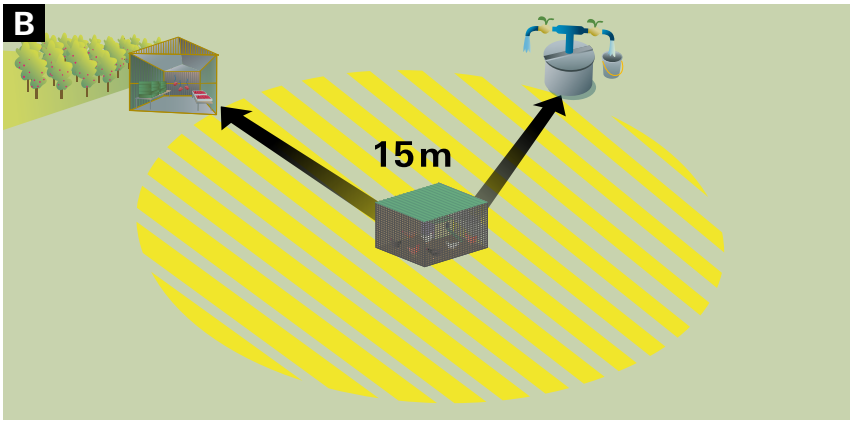
Farm animals (cattle, poultry, pigs…)

A **Keep farm animals confined or prevent their entry in the crop production area using physical barriers (fences). Inspect the good condition of the fences and restore if necessary.**

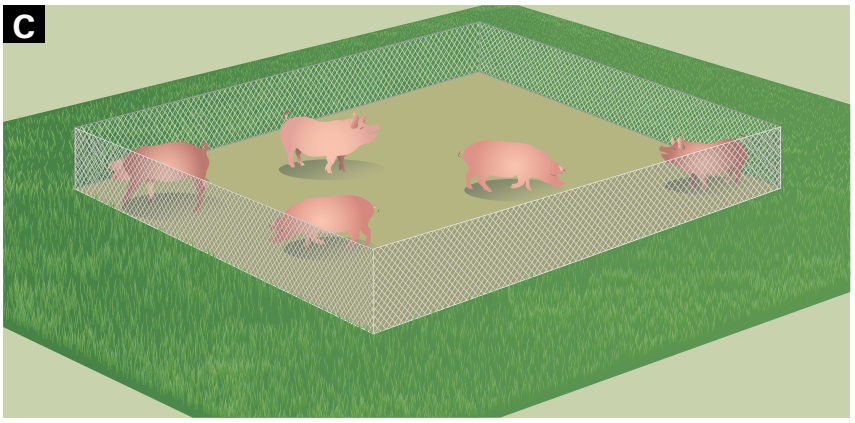




B **Locate animals at least 15 meters (and if possible downhill) from agricultural water sources (e.g. ponds, wells), growing fields and storage areas.**



C **Consider the implementation of vegetated buffer strips (e.g. grass strips) around animal areas, to reduce contamination from runoff.**

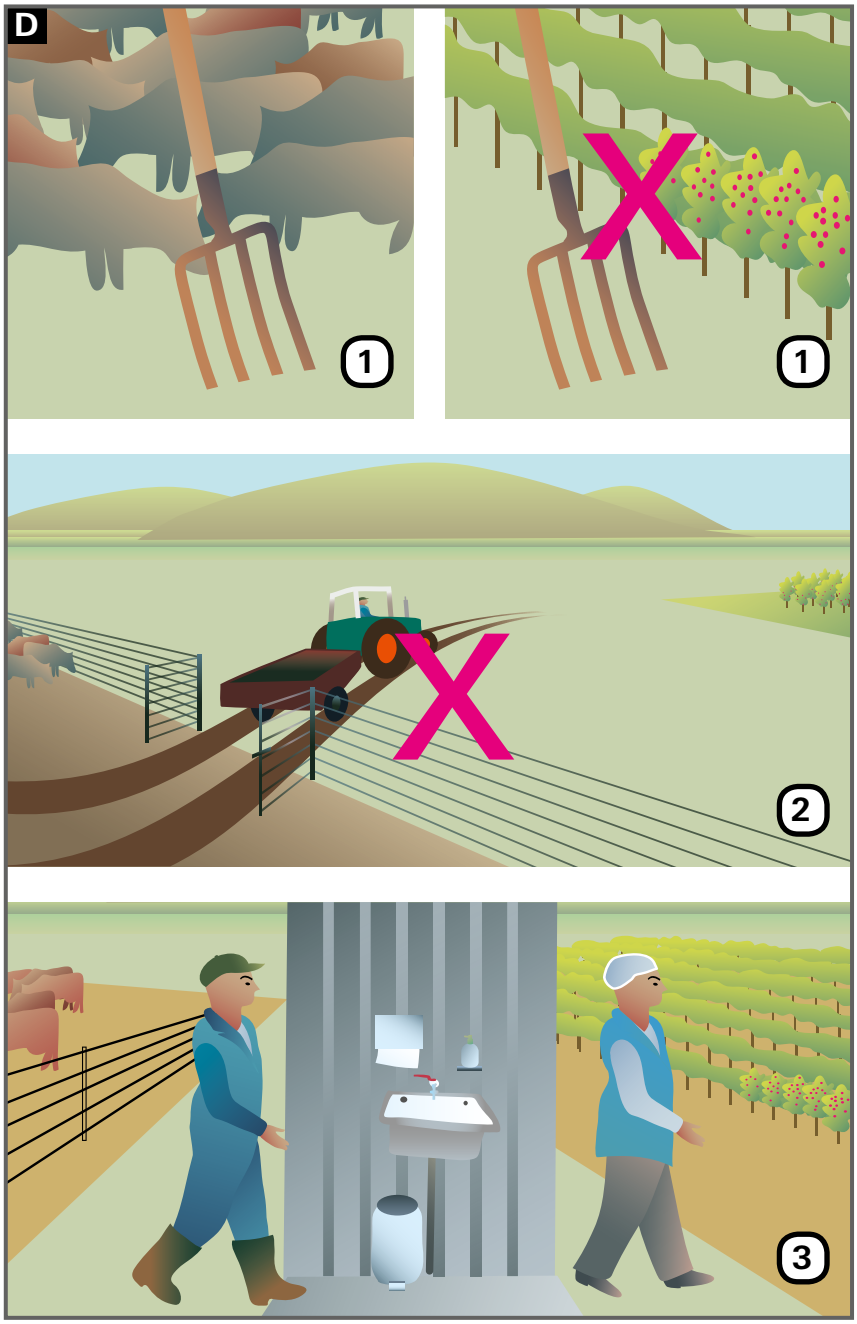


Farm animals (cattle, poultry, pigs…)

D **Avoid cross contamination from farm animal activities to the crop production area by:**

1. **Not using utensils and tools from farm animal activities for activities related to crop production, unless they have been cleaned and sanitized. If possible, use dedicated tools for farm animal activities and for crop production;**
2. **Restricting vehicles associated with farm animal activities from entry to the crop production area;**
3. **Washing hands and changing boots (and changing clothes if necessary) while moving between animal and crop production area.**

If farm animal activities cannot be conducted in ways which prevent animal fecal contamination of the produce (e.g. through run-off, aerosols...), these farm animal activities and berry productions should not be performed at the same farm!

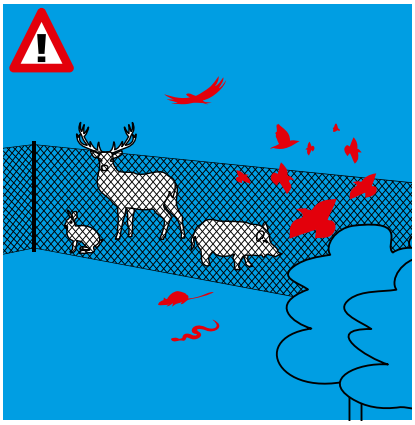


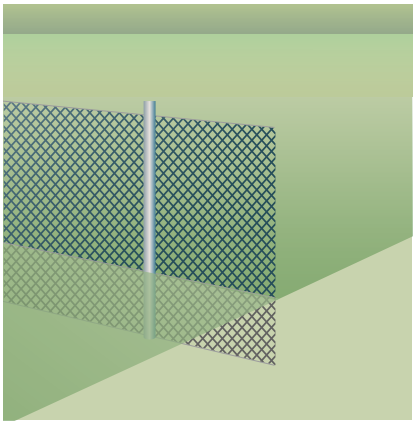
Wild animals (deer, wild pigs, birds, rabbits, reptiles, rodents…)

Farmers should be careful to not endanger protected species or remove their habitat.

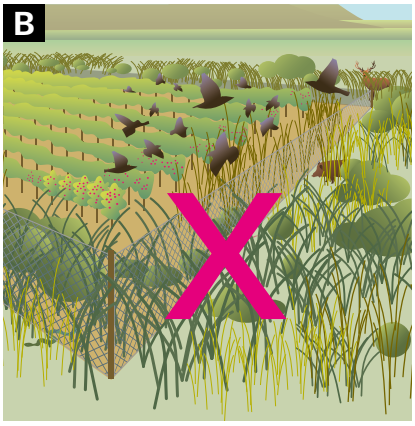
A **Prevent the entry of wild animals onto the crop production area using fences (unless it has been demonstrated that there is no risk associated with wild life). Inspect the good condition of the fences and restore if necessary.**

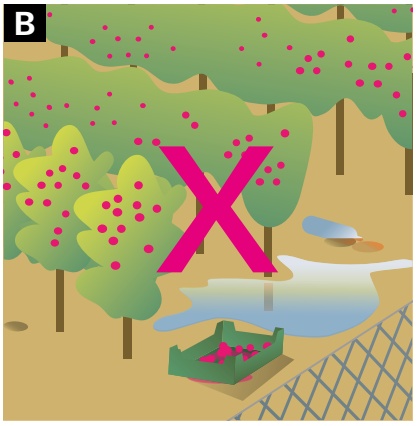
Fences are only effective for larger animals such as deer or wild pigs, but are not completely effective for birds or small terrestrial animals such as rodents and reptiles. Furthermore, it is best to build the fence into the ground to make it more effective against animals that can burrow into the ground (underneath the fence) such as rabbits.

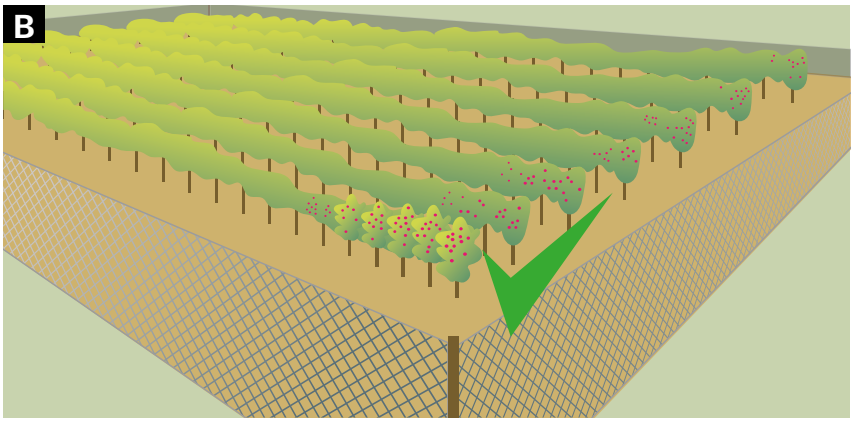




B **Minimize habitat, nesting, hiding places and feeding of birds and small terrestrial animals (e.g. rodents, reptiles) in and around the field:**
- **avoid bushes, cut the grass;**
- **remove waste and avoid stagnant water.**







Wild animals (deer, wild pigs, birds, rabbits, reptiles, rodents…)

Farmers should be careful to not endanger protected species or remove their habitat.

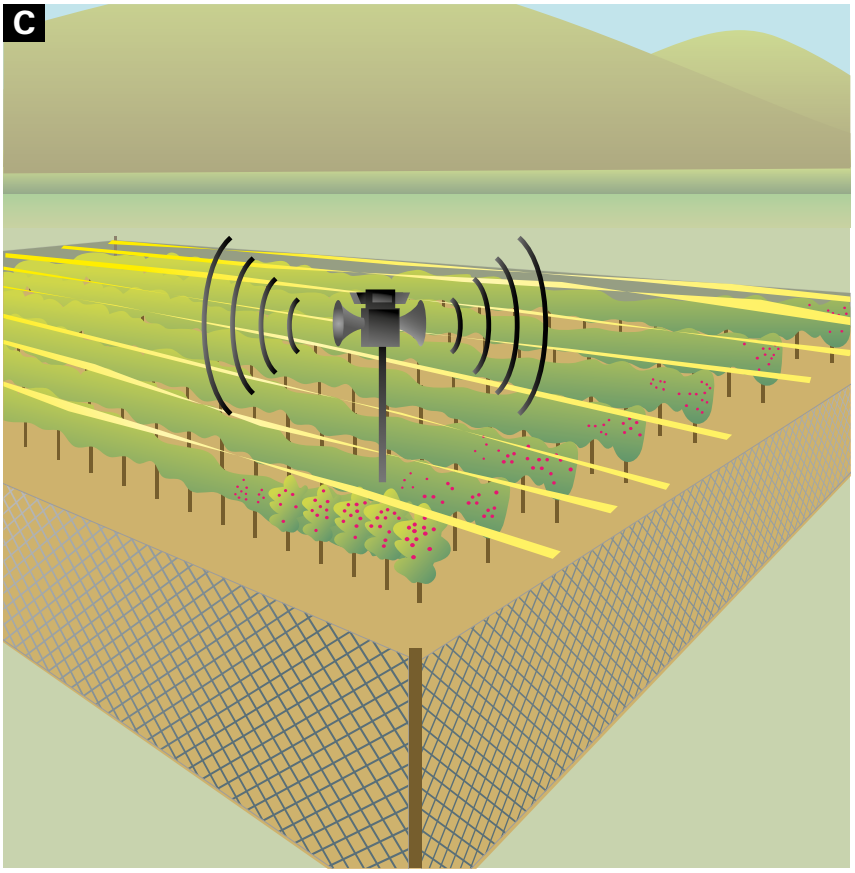
C **Deter birds from the crop field: Make use of visual repellants such as shiny ribbons, reflective strips, scarecrows, or acoustic repellants emitting unfamiliar loud noise, predator bird calls or bird distress calls. Ultrasonic devices are commonly ineffective for many types of birds.**

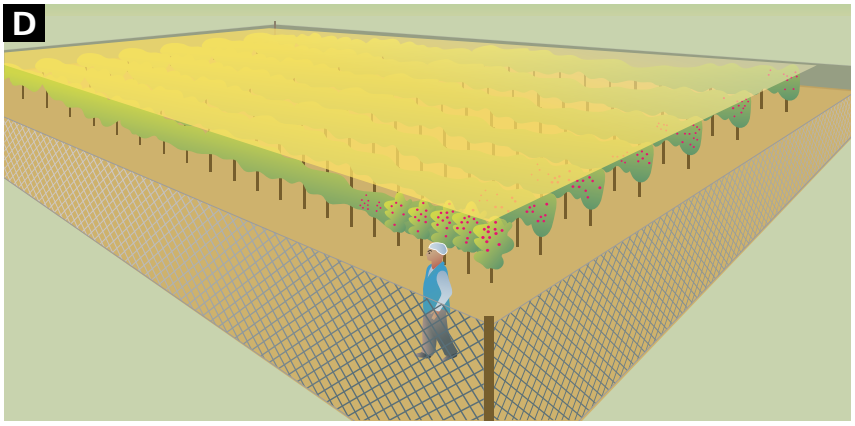
Combined sight and sound repellants which are varied regularly are most successful, since birds can easily overcome repellants.

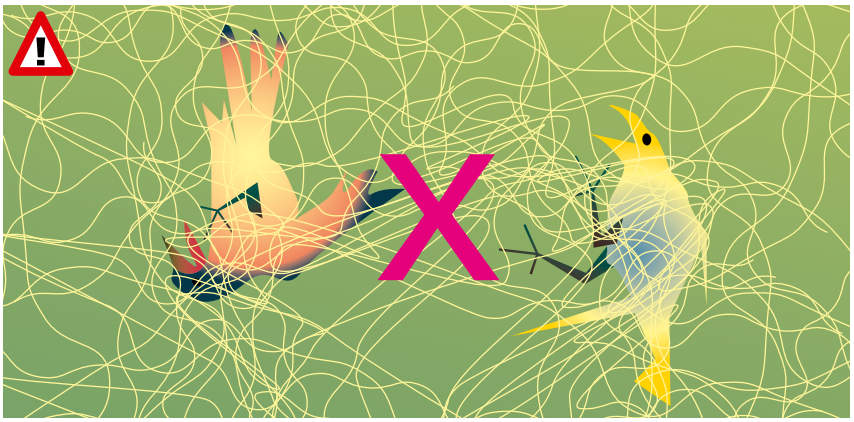
Do not use bird chemical repellants in the crop production area.

D **If necessary, consider the use of nets to protect crop areas from bird invasion.**

Use the right mesh size according to the bird species of concern. An inappropriate size could lead to ineffectiveness or bird injury such as wing damage.







Wild animals (deer, wild pigs, birds, rabbits, reptiles, rodents…)

Farmers should be careful to not endanger protected species or remove their habitat.

E **Do not use rodenticides in the growing field, mainly because of the risk of secondary poisoning of other animals.**

To prevent contamination from rodents, the focus should be on "restriction measures" minimizing hiding places and feeding, such as described in B.

F **If restriction measures are not effective enough to control rodents in the growing field, traps may be used. These traps must be legal in the country of use and live traps (i.e. no killing) should be favored as far as possible.**

A competent professional should be consulted to ensure the legality and design of the trap, so that the correct species is targeted. If you do not know whom to contact, discuss first with your berries purchaser.

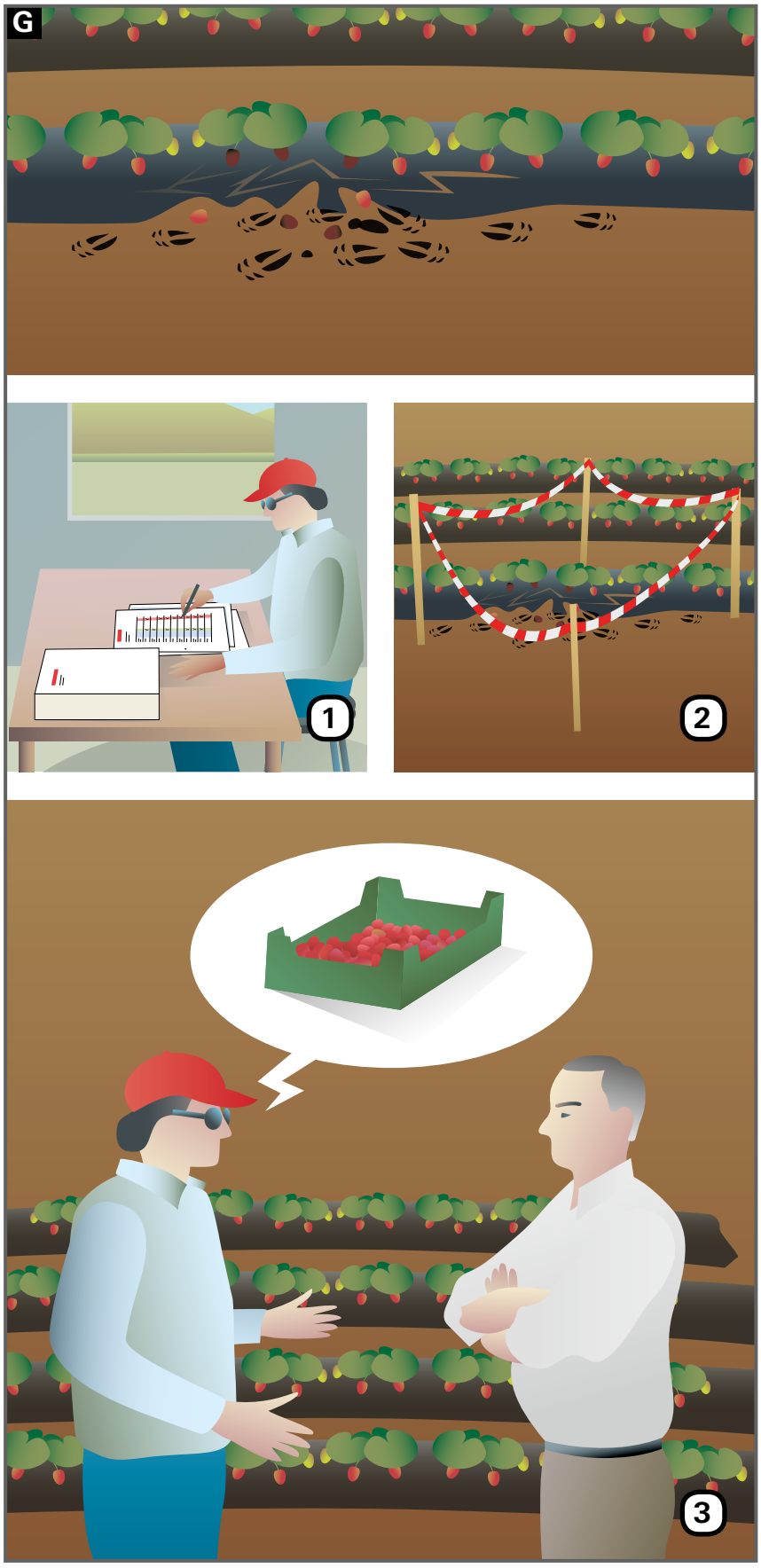
Wild animals (deer, wild pigs, birds, rabbits, reptiles, rodents…)

Farmers should be careful to not endanger protected species or remove their habitat.

G **Before harvesting, scouting for signs of substantive intrusion in the field should be performed (e.g. tracks, gnawing, burrowing etc.). When clear evidence of intrusion is found:**

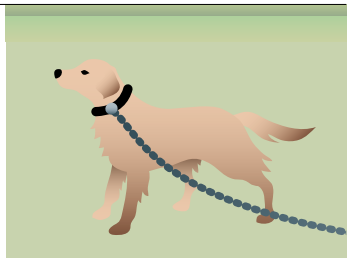
1. **This should be reported and recorded;**
2. **Access to this zone should be restricted and berries should be harvested separately;**
3. **Further use of berries from this zone should be discussed with your berries purchaser.**

If animal faeces are found in the field, this area should not be harvested. The no-harvest buffer zone should have a 1.5 m radius.

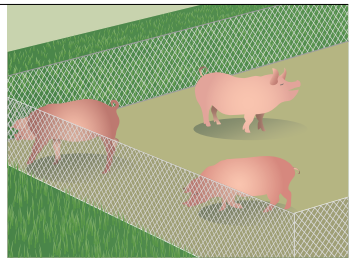


Animals: REMEMBER!

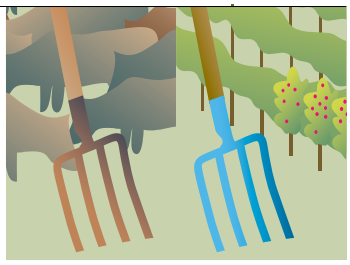
1. Control movements of domestic animals.



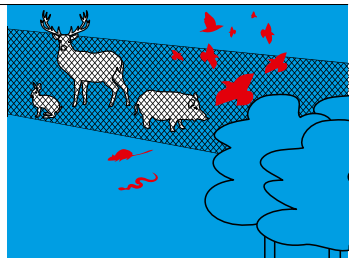
2. Keep farm animals confined and far away from water sources, growing fields and storage areas.



3. Use dedicated tools for farm animal activities and berries.

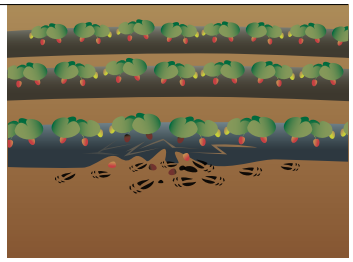


4. Prevent intrusion and minimize habitat of wild animals in the crop production area e.g. using fences and bird repellants, avoiding waste.

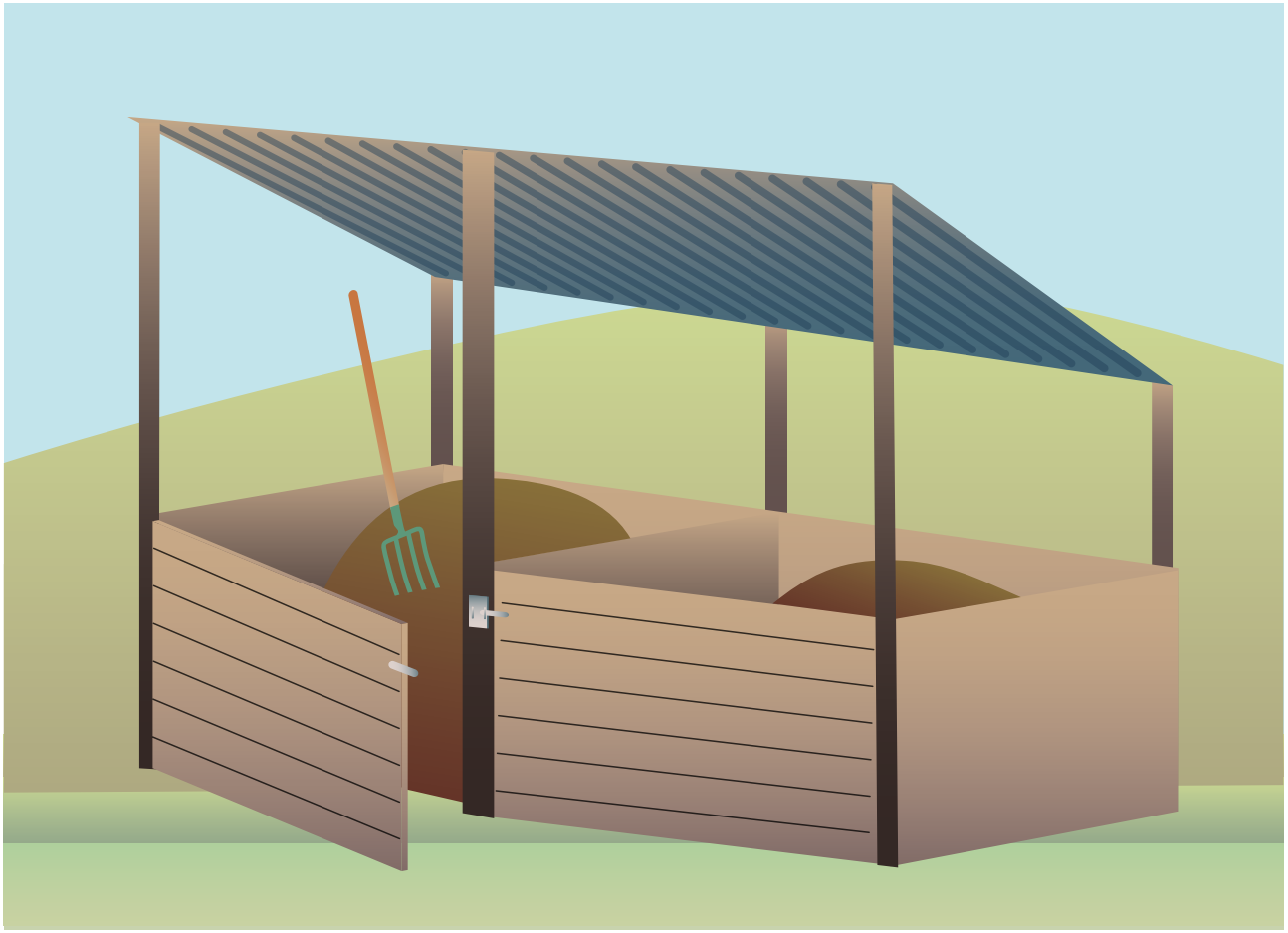


5. Do not use rodenticides or chemical bird repellants in the growing field.

6. Take corrective actions when clear evidence of animal intrusion in the field is found.

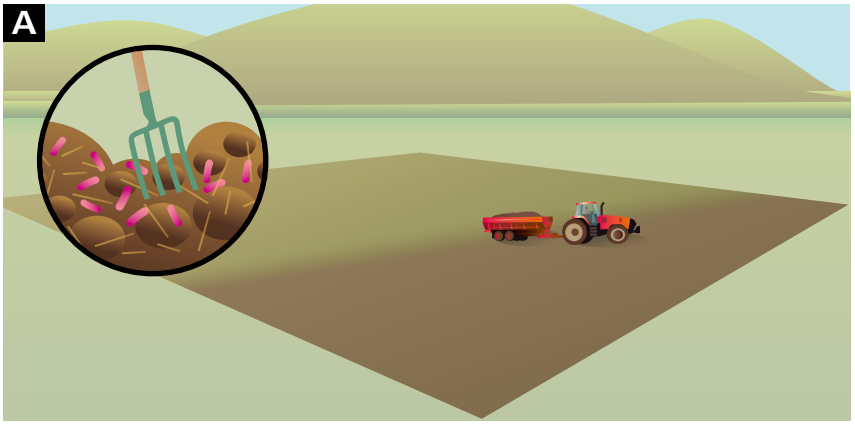


3. Manure-based soil amendments



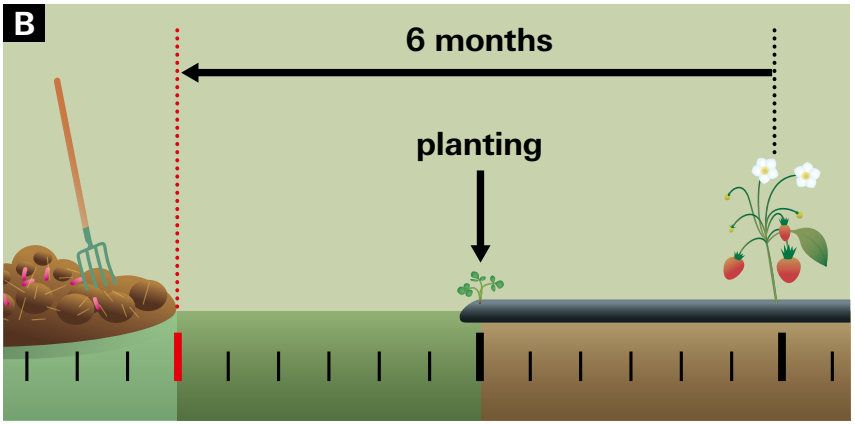
Use and application of raw manure in soil

A **Apply raw manure prior to planting (perform immediate incorporation of manure after spreading to get best effects of nutrients).**

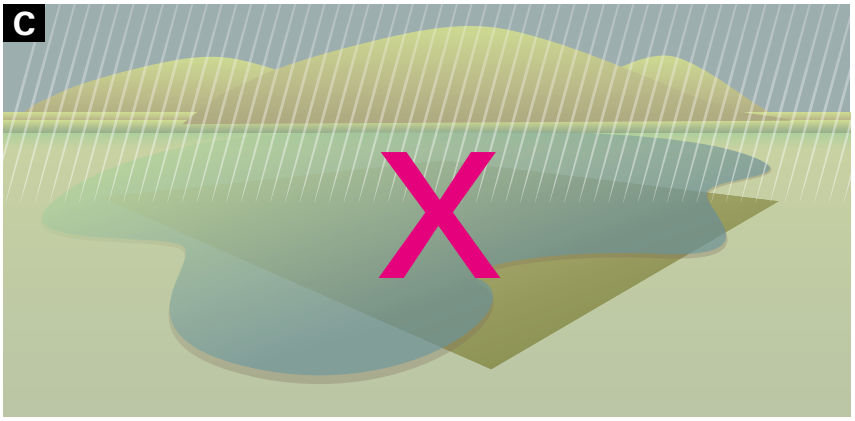


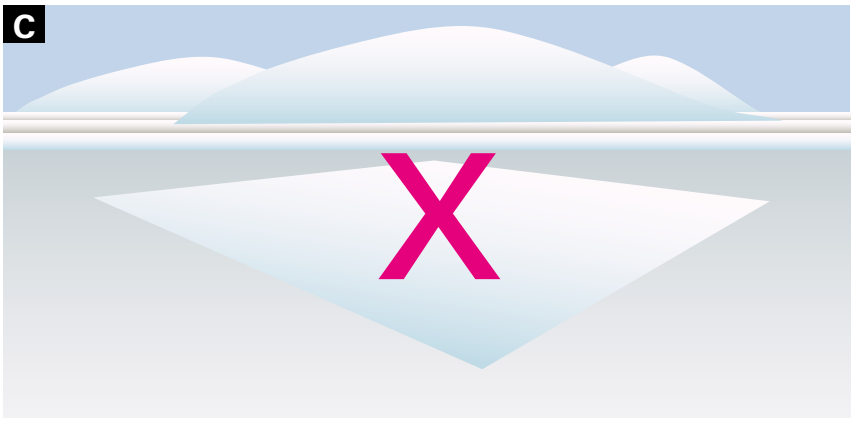
B **Apply raw manure at least 6 months before harvest.**

When it is not possible to apply this interval restriction, do not use raw manure.



C **Do not spread raw manure on fields that are water saturated, prone to annual flooding/ run-off, frozen or snow-covered.**



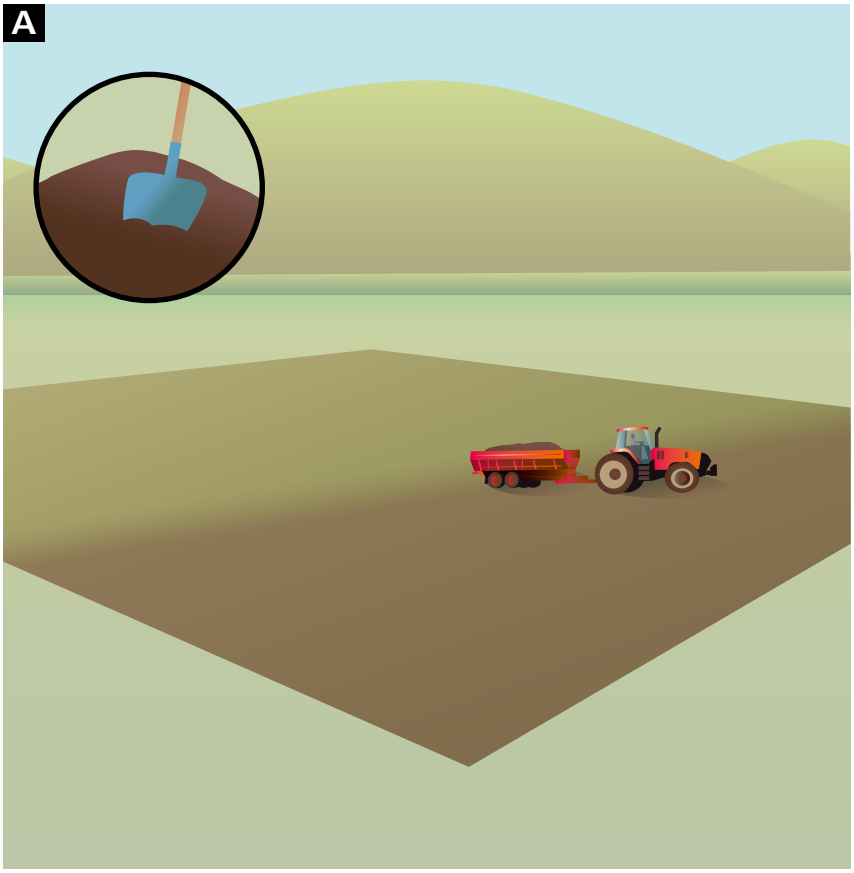


Use and application of treated* manure in soil

***treated by a scientifically valid controlled process (e.g. controlled composting)**

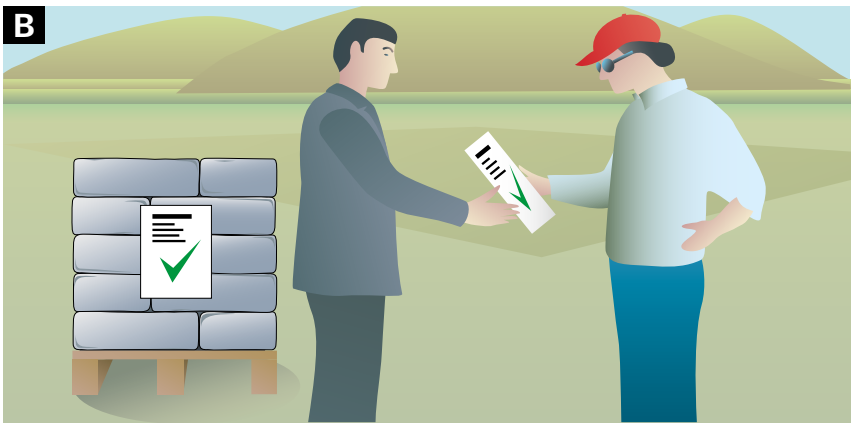
A **Apply treated manure prior to planting. The 6 month interval restriction of raw manure (see B page 27) does not apply for treated manure.**

For perennial crops (e.g. raspberries), when absolutely essential to the production system, treated manure can be also applied during the dormant period but only where edible part of the crop will not come into physical contact with the manure/soil.



B **If treated manure is purchased from an external source (commercially treated), it should be purchased only from suppliers which provide information on:**

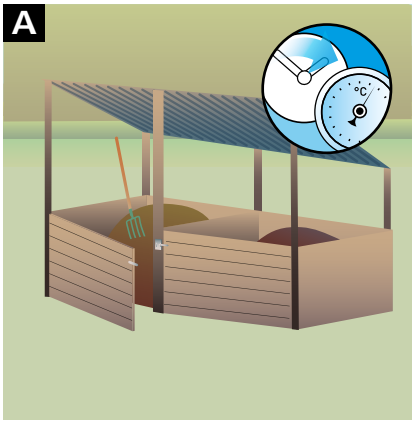
- **origin;**
- **treatment used;**
- **tests performed and test results showing that human pathogens of concern have been effectively controlled (see section E "On-farm composting of manure", page 31).**

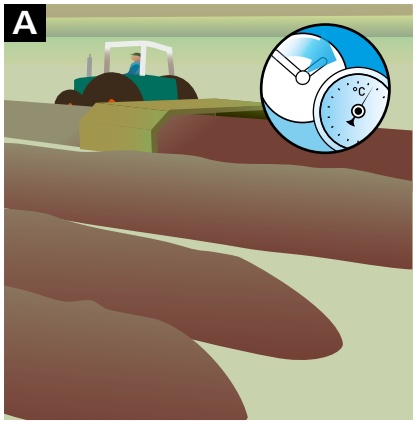


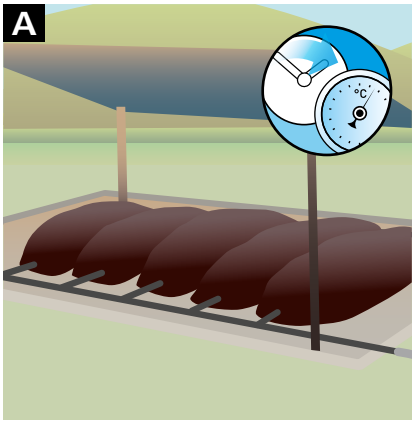
Treatment of manure: On-farm composting of manure with a controlled process

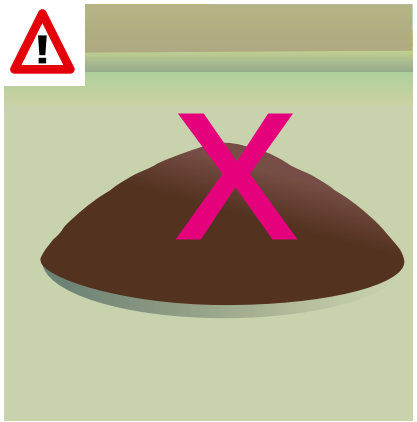
A For any type of composting (i.e. turned pile/ turned windrow composting or static aerated composting), raw manure has to remain for a period of time at a designated temperature.

Simple stock piling is not appropriate to ensure that all pathogenic bacteria and/or viruses have been killed.







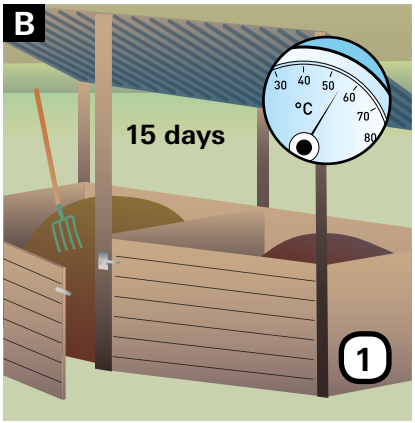


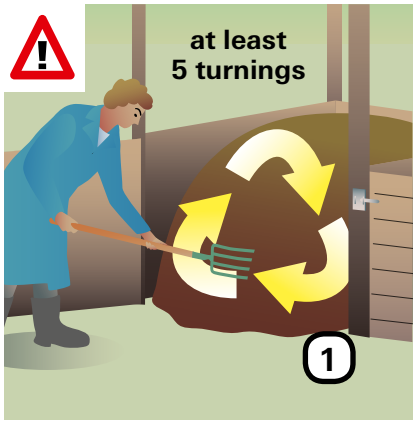
B The temperature needs to reach:

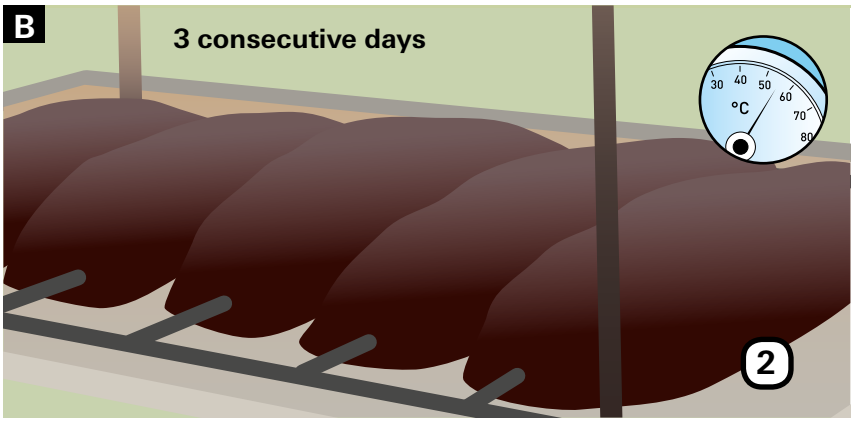
1. At least 55°C for 15 days (need not be consecutive) in the hot zone of a turned pile/ turned windrow, with at least 5 turnings (around 3 times a week).

Piles/windrow should be turned so that the outer mass can be exposed to the highest temperature inside the pile.

2. At least 55°C for 3 consecutive days in a static aerated pile.

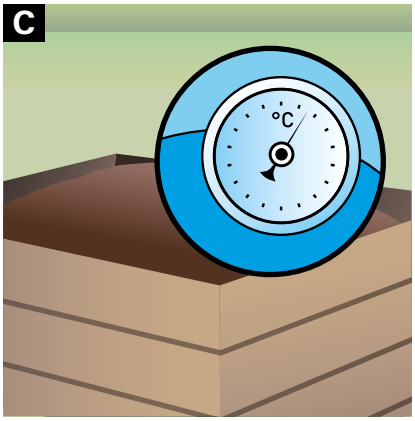


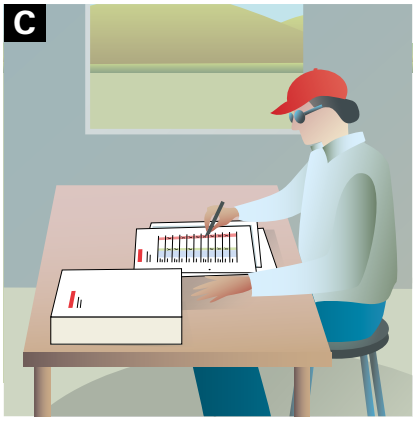




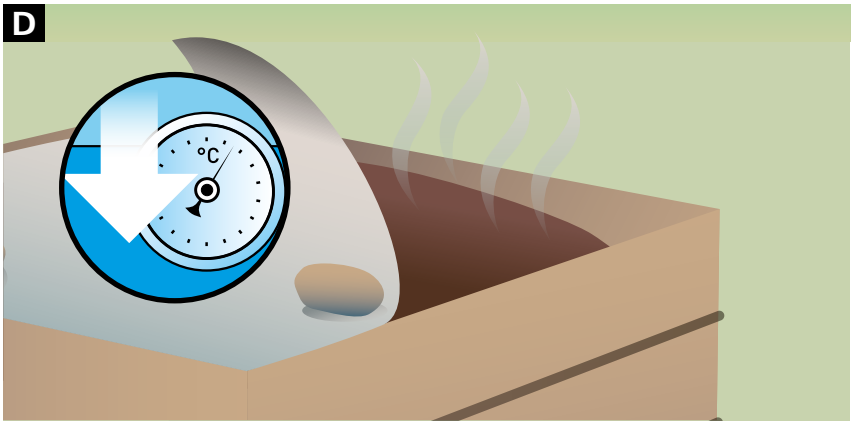
Treatment of manure: On-farm composting of manure with a controlled process

C **Monitoring and recording of the temperature at selected places within the manure pile has to be performed, as well as recording of time (days) and number of turnings (when applicable).**





D **After the correct period of time at the designated temperature, allow temperature of the manure to decline gradually (approximately 45 days) to reach cooler conditions (the curing stage). This curing stage generates a stabilized compost which is dark brown, crumbly and earthy-smelling.**



Treatment of manure: On-farm composting of manure with a controlled process

E **Pathogen testing should be performed by a laboratory ISO 17025 accredited for method of testing (or one approved by an official government scheme), at least once to validate the compost process (at the end of the curing stage):**

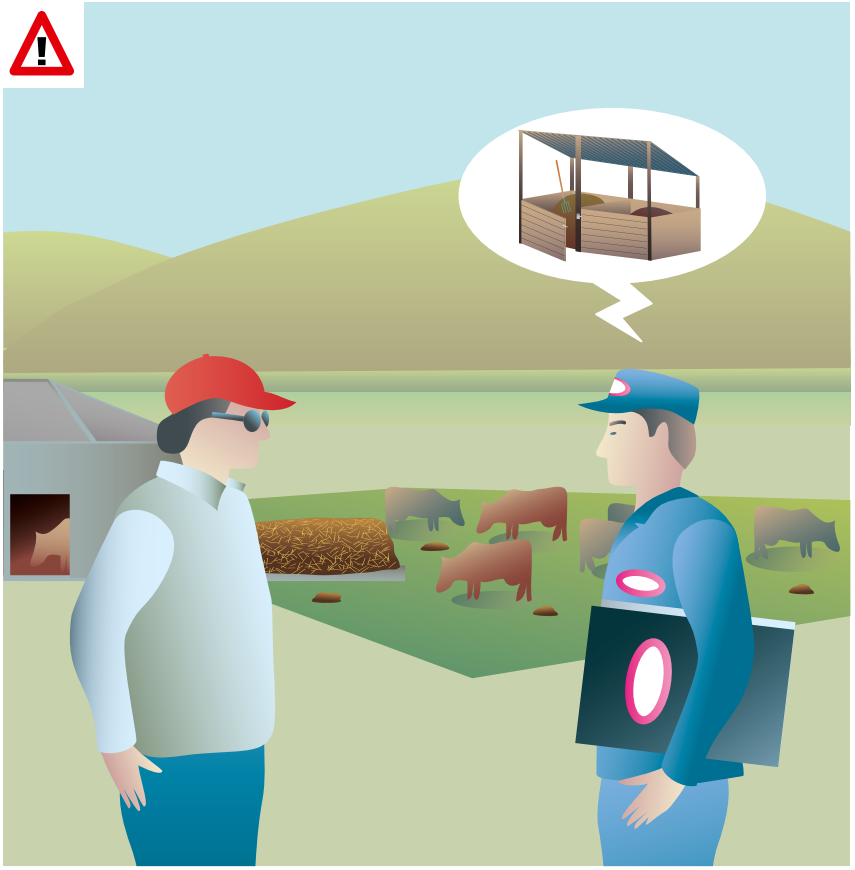
- ***Salmonella*** **absence in 25g portion;**
- **And *Listeria monocytogenes* absence in 25g portion;**
- **And *E. coli* < 1000 CFU/g;**

- **Or according to local regulation.**

Before initiating on-farm composting, a competent professional should be consulted to ensure the treatment will produce stabilized compost that can meet the microbial standards. If you do not know whom to contact, discuss first with your berries purchaser.

E

Salmonella **absence in 25g**
L. mono **absence in 25g**
E. coli **< 1000 CFU/g**

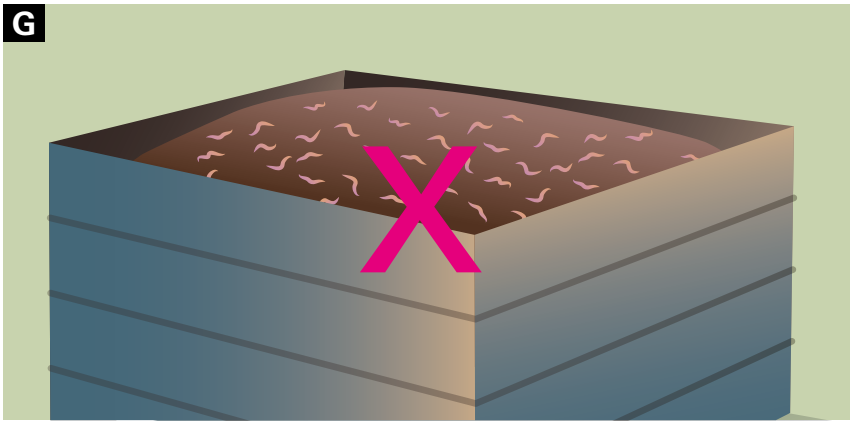


Treatment of manure: On-farm composting of manure with a controlled process

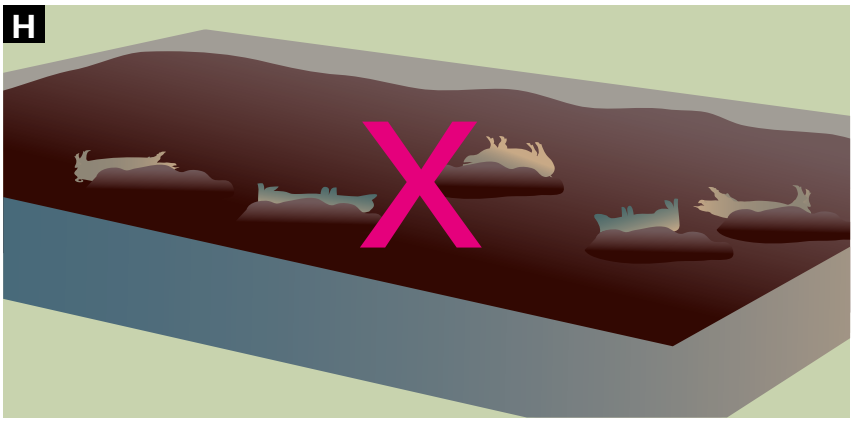
F **Compost tea (made from composted manure steeped in water) should be prepared with:**
- **Potable water (absence of *E. coli* in 100 mL);**
- **Properly composted manure (see A to E).**

Do not use compost tea for which production process uses supplemental nutrients because these nutrients can support growth of even a few surviving cells of pathogenic bacteria.

G **Do not use Vermicomposting of manure (worm composting), unless manure is pretreated by a thermal method or significantly diluted (50% at least) before worm composting.**

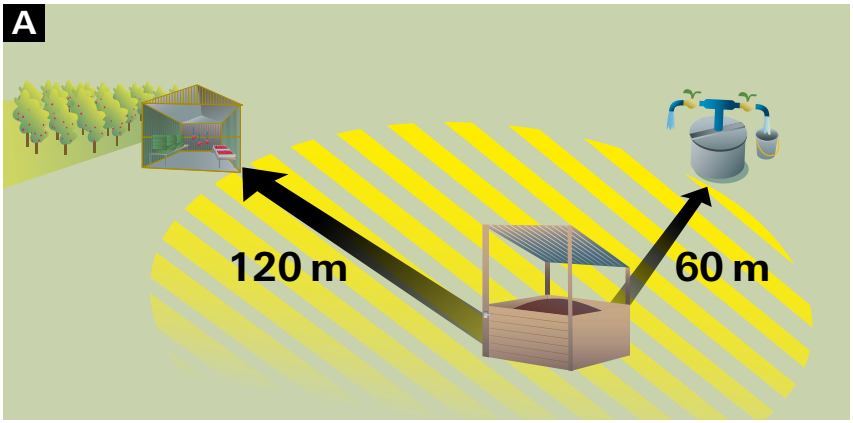


H **Do not use carcass composted products or untreated human sewage sludge.**

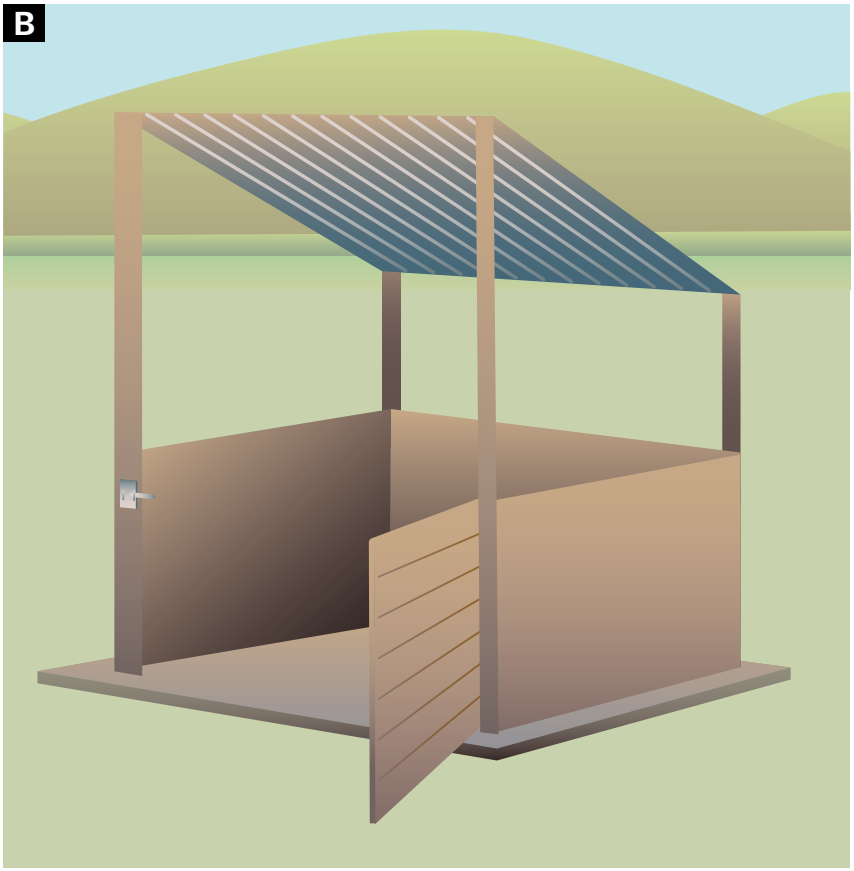


Cross-contamination between raw manure/composting activities and crop production area

A **Keep raw manure storage and composting areas far away from growing field and harvested produce (at least 120 meters) and from water sources (at least 60 meters).**



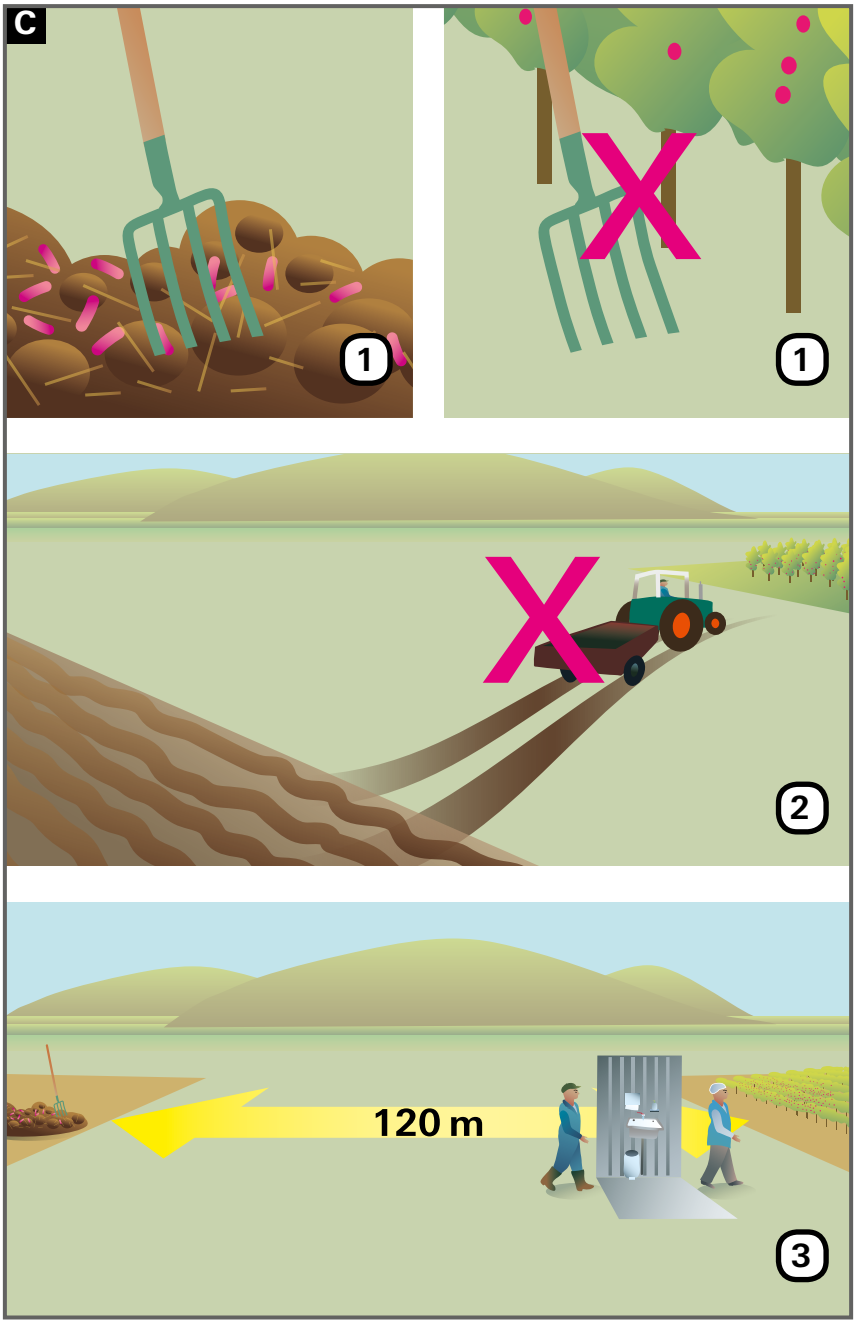
B **Avoid any risk of leakage or wind spread of raw manure during composting by using:**
- **Physical barriers such as wall, sheeting;**
- **Appropriate covering;**
- **A stabilized surface.**



Cross-contamination between raw manure/composting activities and crop production area

C **Avoid cross contamination from raw manure and composting activities to the crop production area by:**

1. **Not using utensils and tools from raw manure and composting activities for activities related to composted manure and plant produce, unless these equipment or tools have been cleaned and disinfected. If possible, use dedicated tools for raw manure/composting activities, for composted manure and for produce.**
2. **Avoiding vehicles from these raw manure and composting activities to enter the crop production area during growing season and harvesting.**
3. **Washing hands and changing boots (and changing clothes if necessary) when going from raw manure/composting area to crop production area during growing season.**

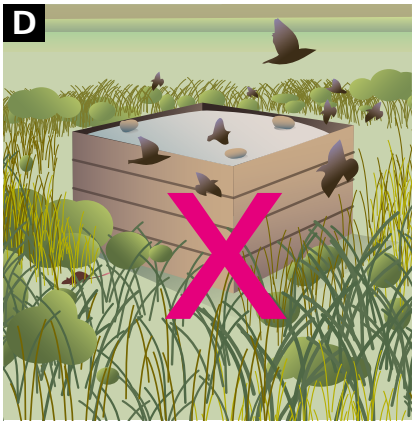


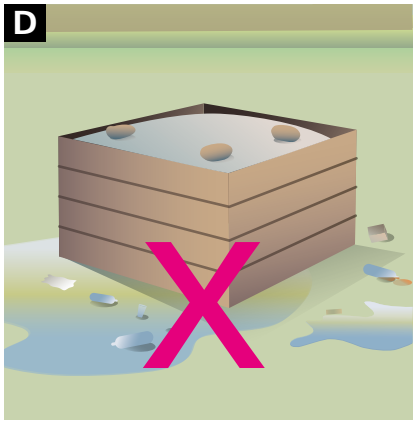
Cross-contamination between raw manure/composting activities and crop production area

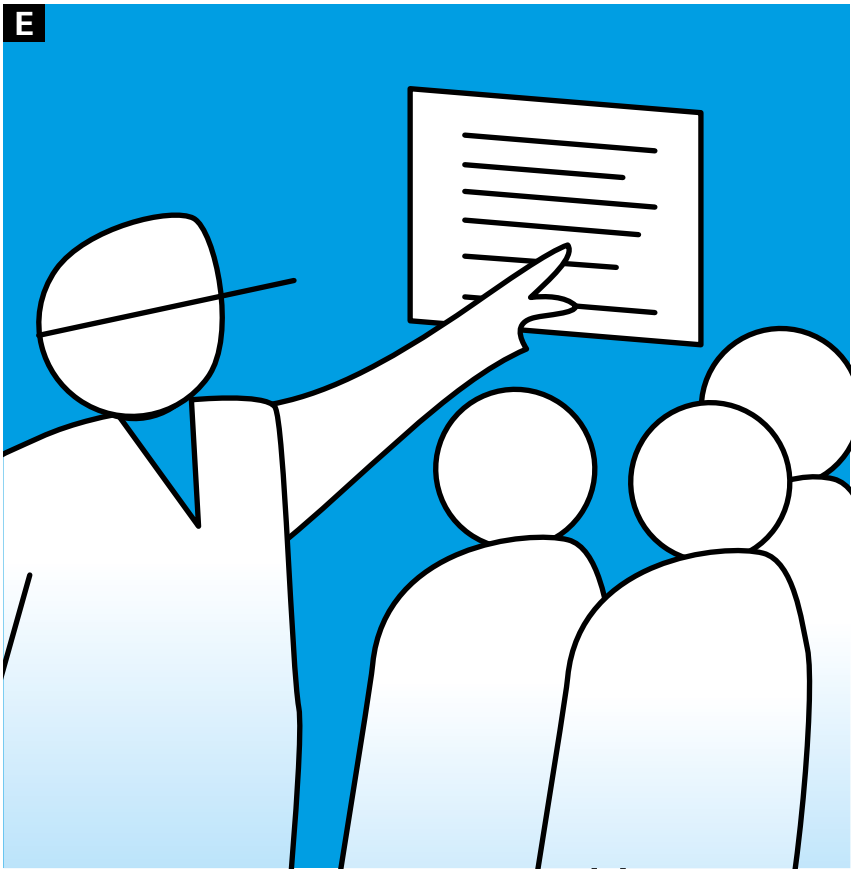
D **Minimize for the potential recontamination of composted manure by:**
- **Using covered storage;**
- **Avoiding bushes and cutting the grass around storage to avoid pest nesting;**
- **Removing waste and avoiding stagnant water around storage.**

E **Train employees on the risk of raw manure and composting cross-contamination.**

Do not discharge untreated or improperly treated manure and faeces into surface waters.

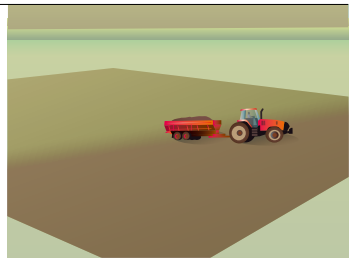




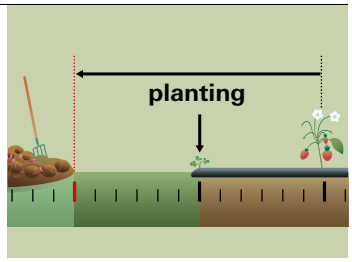


Manure-based soil amendments: REMEMBER!

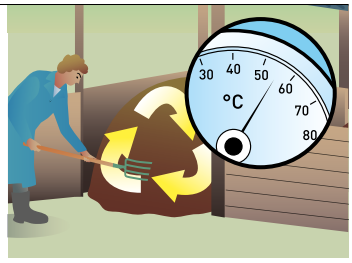
1. Apply manure prior to planting.



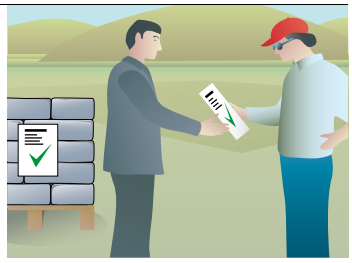
2. Apply raw manure at least 6 months before harvest.



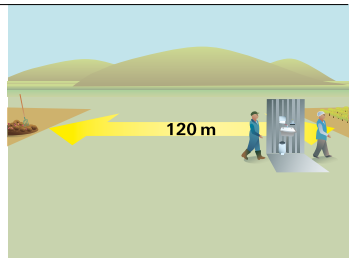
3. Use composted manure which has followed controlled composting (rather than simple stock piling): record temperature, time and, when applicable, number of turnings.



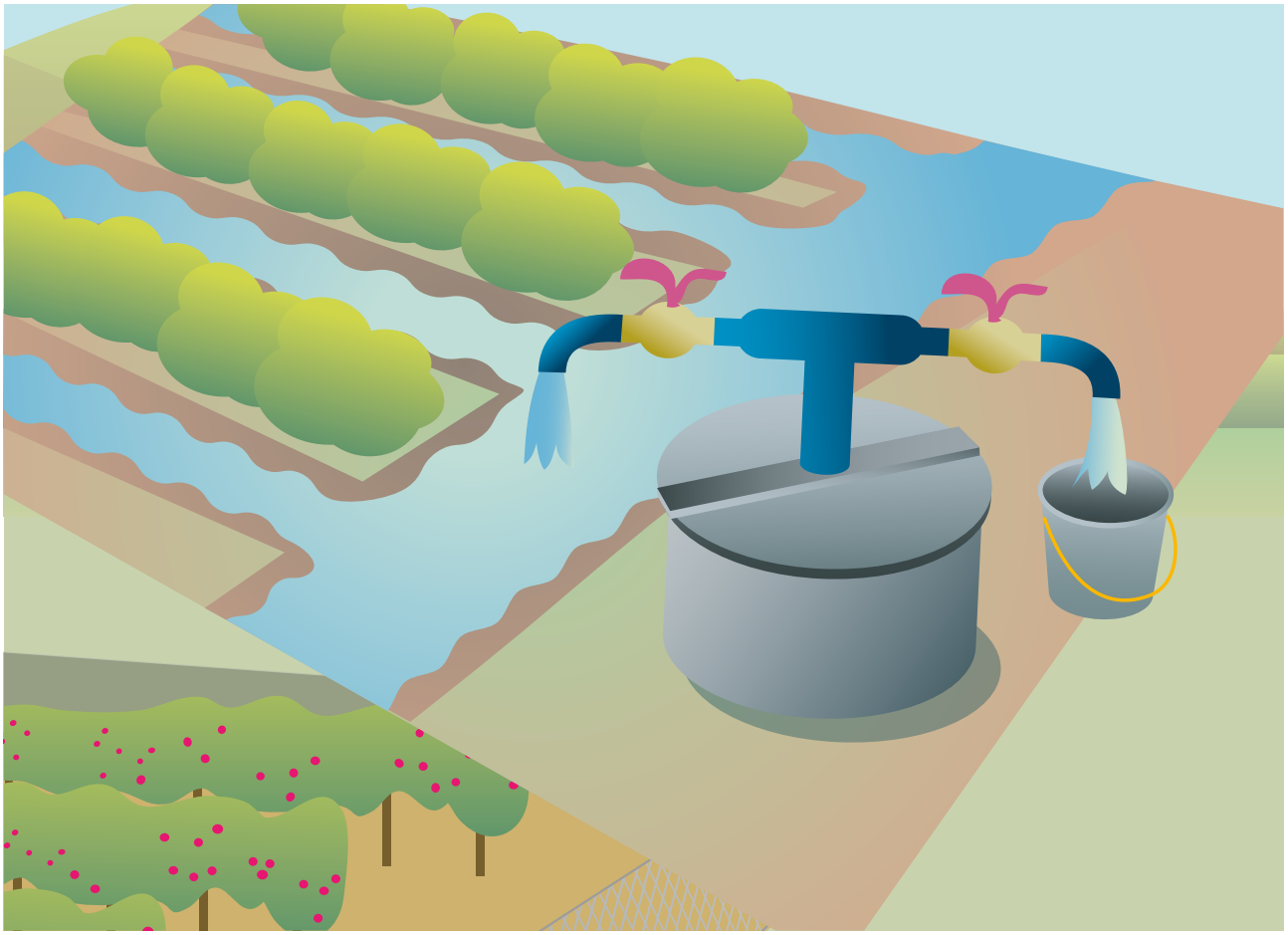
4. Validate on-farm controlled composting and/or ask for a certificate of compliance if you purchase treated manure from an external source.



5. Avoid cross-contamination between raw manure/compositing areas and crop production area.



4. Agricultural water

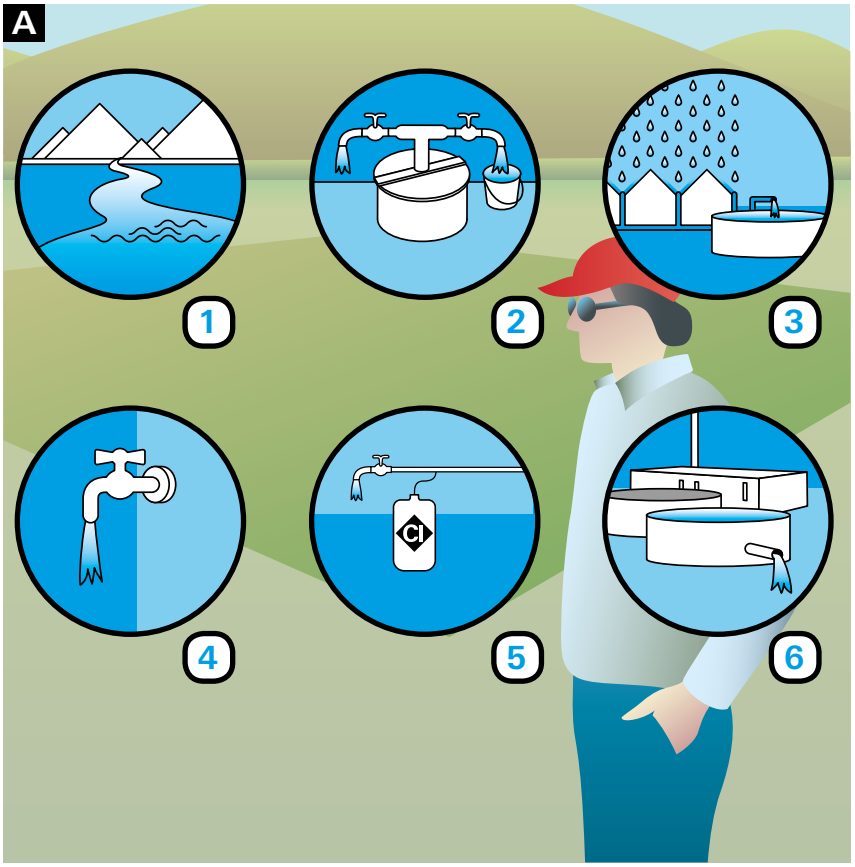


Water source and irrigation method (Type A and Type B water)

A **Identify the source of the water to be used for applications listed in section B:**

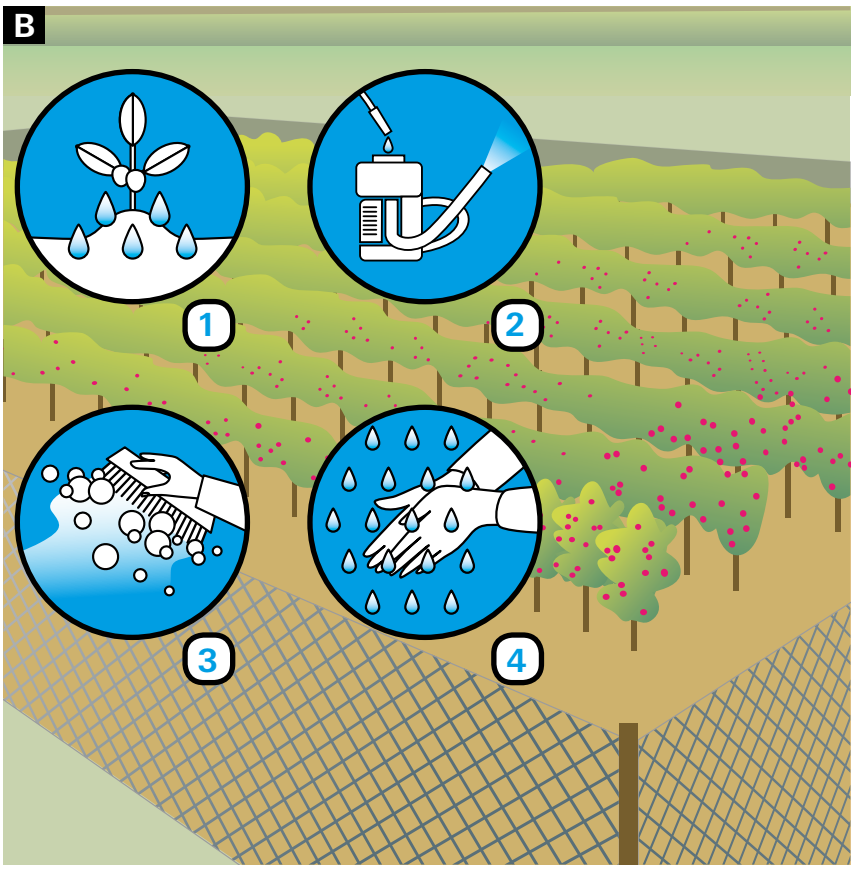
1. **Surface water;**
2. **Ground water (= well water/borehole), either from deep or shallow well);**
3. **Harvested rain water;**
4. **Municipal water (i.e. potable water);**
5. **Disinfected water (e.g. chlorinated) on farm;**
6. **Secondary treated sewage water.**

DO NOT use untreated sewage water as agricultural water.



B **The identification of the water source has to be performed individually for the following water applications:**

1. **Irrigation;**
2. **Pesticide dilution;**
3. **Cleaning of equipment in contact with produce (e.g. harvesting equipment);**
4. **Worker hand washing.**



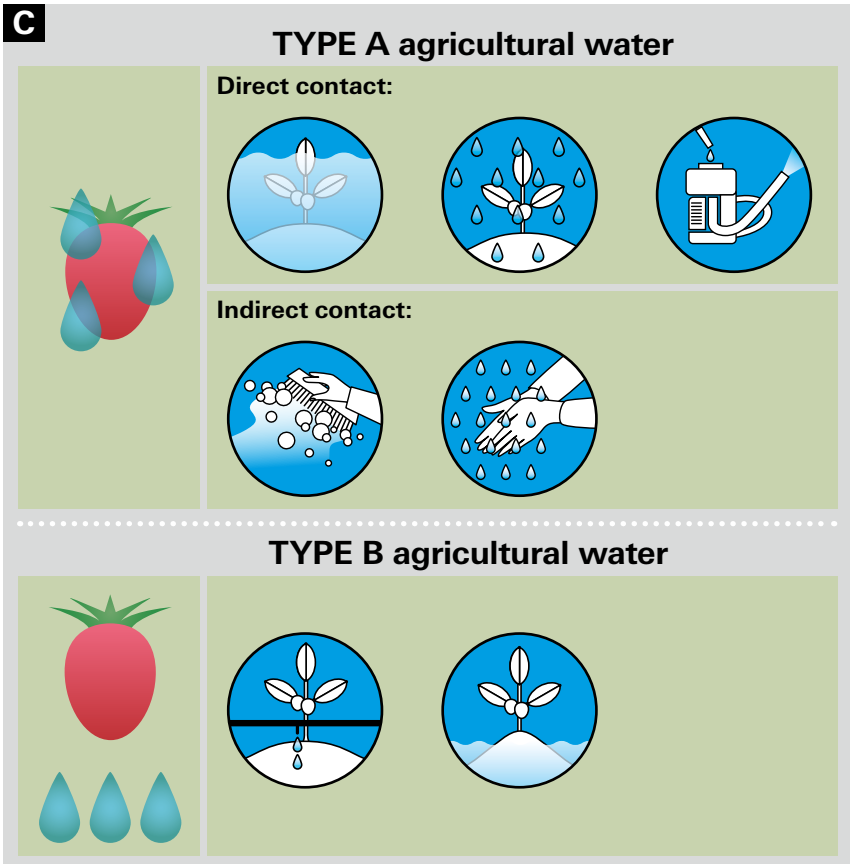
Water source and irrigation method

C Depending on its use, there are two types of agricultural water:
- TYPE A agricultural water: Agricultural water having direct or indirect contact with produce. Direct contact: e.g. water used for overhead or flood irrigation, water used for dilution of pesticides. Indirect contact: e.g. water used for cleaning of equipment in contact with produce, water used for hand washing.
- TYPE B agricultural water: Agricultural water having no direct or indirect contact with produce, e.g. water used for drip or furrow irrigation (provided there is no risk that water from the furrow splashes onto the produce).

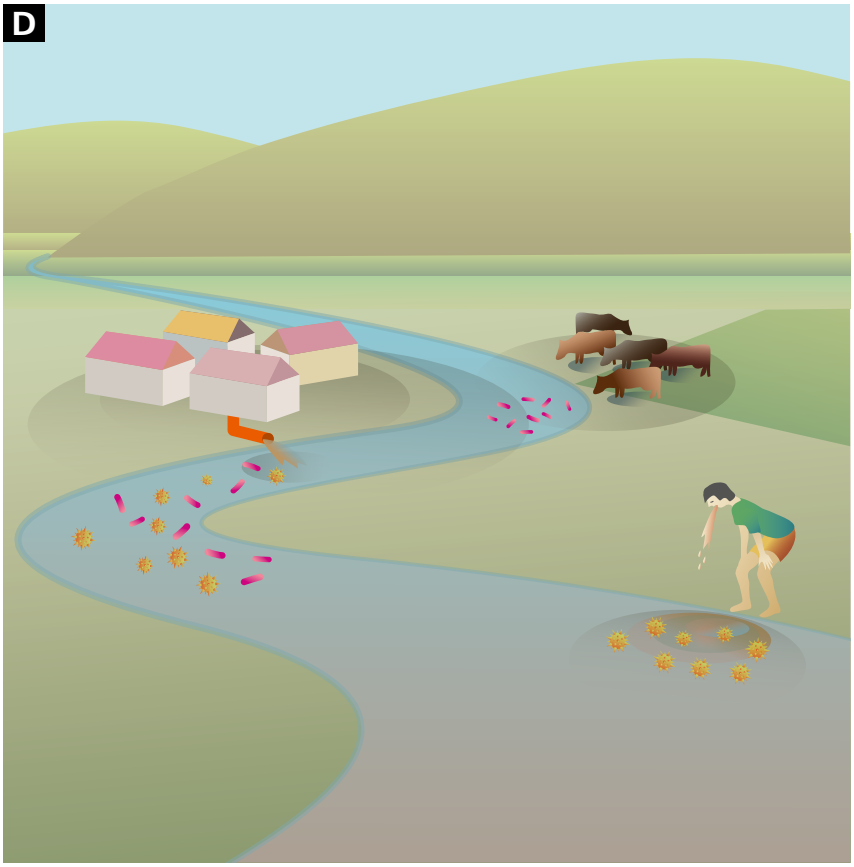
D Surface water is vulnerable to microbial contamination from human and animal activities. Secondary treated sewage water (not disinfected) may still contain microbial pathogens.

! Therefore, do not use surface water and secondary treated sewage water as type A agricultural water, unless treated (disinfected).

C



D



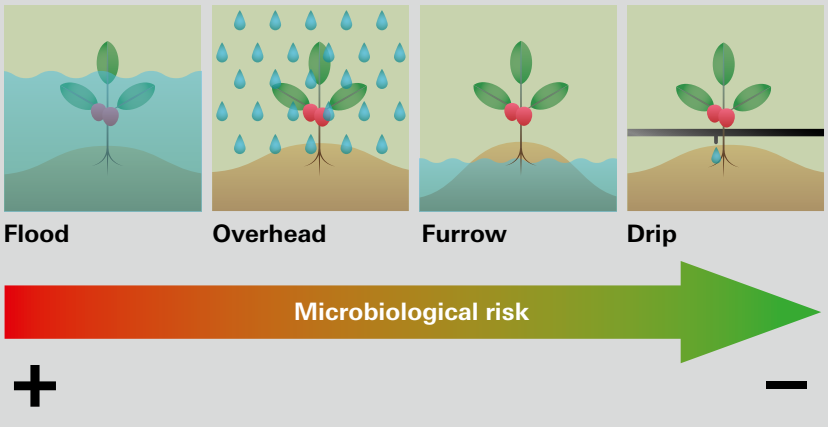
Water source and irrigation method

E **The risk of microbial contamination will vary depending on the irrigation method, i.e. the risk will increase when there is contact between water and produce. Therefore:**

- **Use of drip or furrow irrigation of berries is recommended.**
- **Where possible minimize the use of overhead irrigation.**
- **Flood irrigation is not recommended, unless specifically used to assist harvesting (e.g. for cranberries).**

Table 1 (see page 51) summarizes the level of microbiological risk according to the water source and its application type.

E

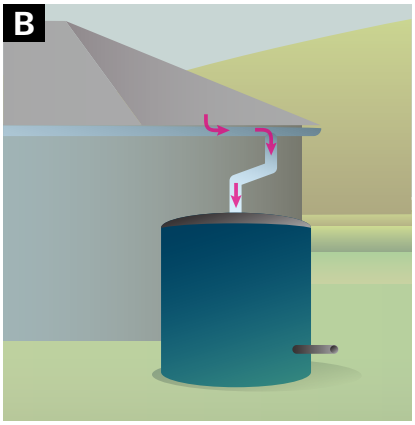


Wells, water collection, storage and distribution systems (e.g. tanks, ponds, pipes)

A **Protect well (bore-hole) water from intrusion of surface water, run-off water and animals by:**

- **Using concrete wall construction with intact covering.**
- **Inspecting wells regularly for potential leaks or cracks and repair when needed.**
- **Elevating the edge of the well above the surrounding ground surface.**

B **Harvest rain water using a well maintained clean collection system (e.g. clean roofs without bird nesting, pipes and tanks clean).**



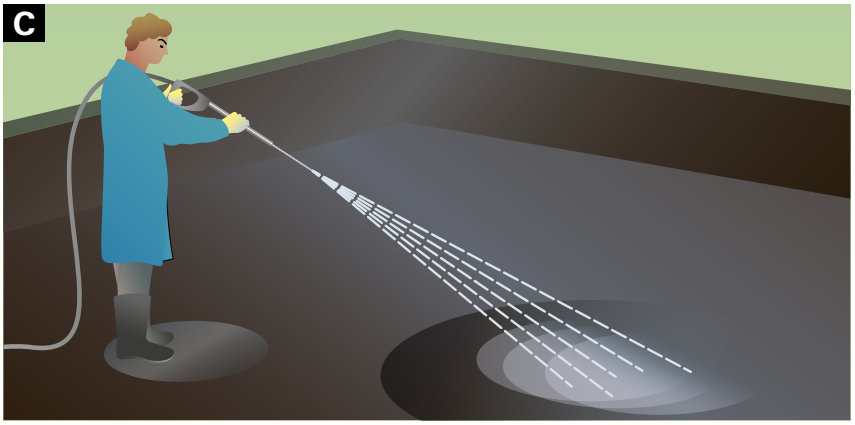
Wells, water collection, storage and distribution systems (e.g. tanks, ponds, pipes)

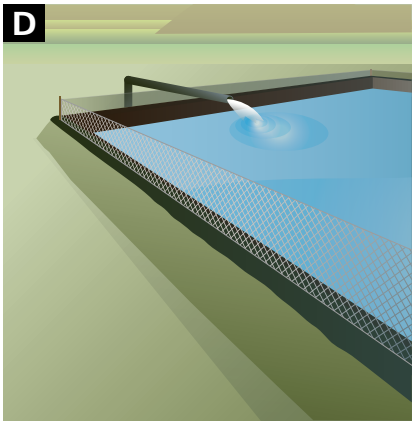
C **Prevent animal ingress into water collection and storage systems:**
– Cover tanks;
– Fence ponds (and cover them if feasible);
– Empty and clean tanks and ponds at least once per year.

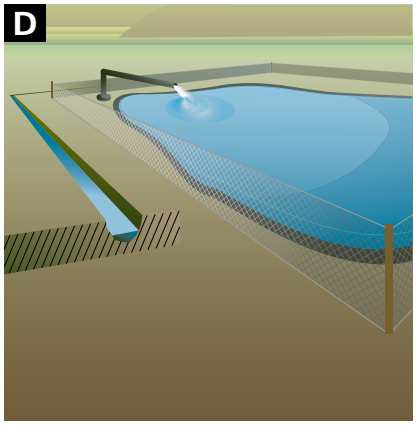
Ponds that cannot be covered are not fully closed storage systems. Care should be taken to ensure the hygiene and biosecurity of the pond is maintained (e.g. yearly cleaning, fences and construction design as defined in D).

D **Build berms (raised soil or grass barriers) or ditches around ponds to prevent overland runoff of manure/compost and other contaminants into the ponds.**

E **Inspect the conditions of pumps, pipes, collection and storage systems regularly for leaks and cracks to ensure the integrity of the water system.**







Wells, water collection, storage and distribution systems (e.g. tanks, ponds, pipes)

Repairing damaged equipment is very important: broken water distribution systems can turn a drip system into an overhead sprinkler, thereby bringing water in direct contact with the edible part of the crop.

F **Minimize biofilm formation in pipes:**
- **Use black pipes that minimize growth of pathogens (including plant pathogens).**
- **Apply disinfection treatment to prevent biofilm formation in the pipes whenever necessary (at least once per year, e.g. before the start of the growing season, using a locally approved disinfectant). Competent personnel should be consulted to ensure type of treatment is fit for purpose (chemical component, concentration, flushing time, rinsing and frequency of treatment). If you do not know whom to contact, discuss first with your berries purchaser.**

G **Keep flood (if applicable) and furrow irrigation channels free of rubbish/waste.**

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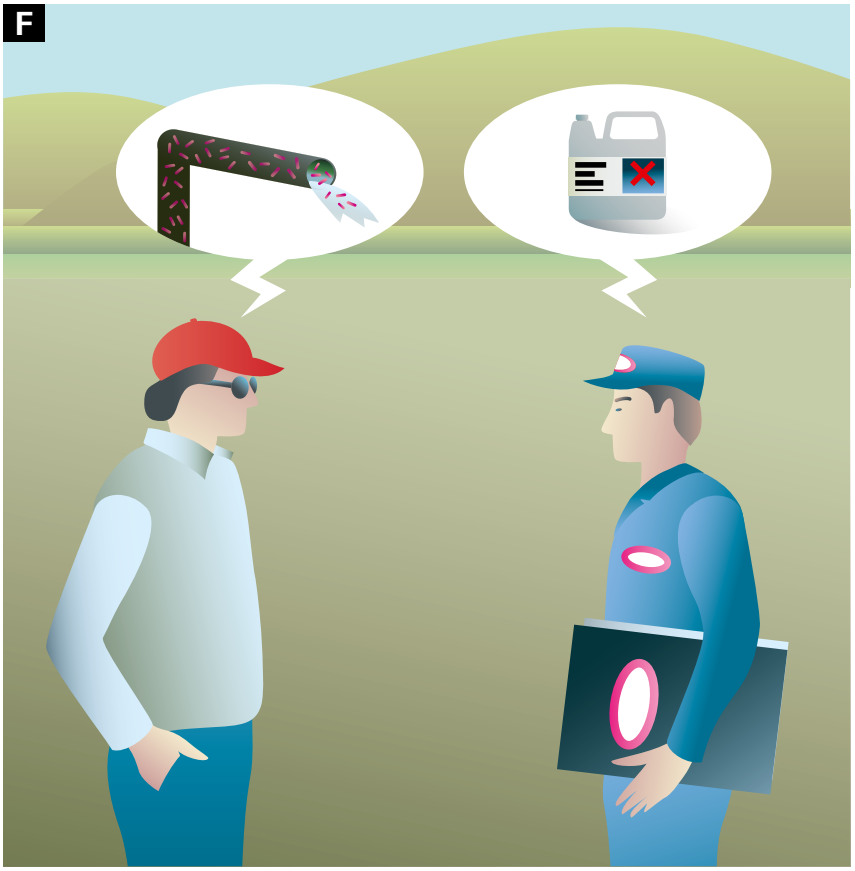

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Agricultural water testing

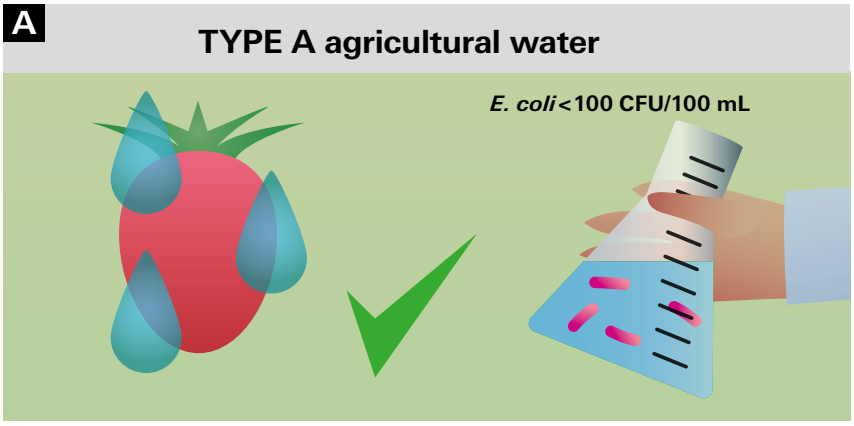
A For type A agricultural water, microbiological water testing for *Escherichia coli* is required (with target levels < 100 CFU/100 mL). The testing frequency will vary according to the water source (see Table 2, page 52–53).

B Microbiological water testing requires two steps:

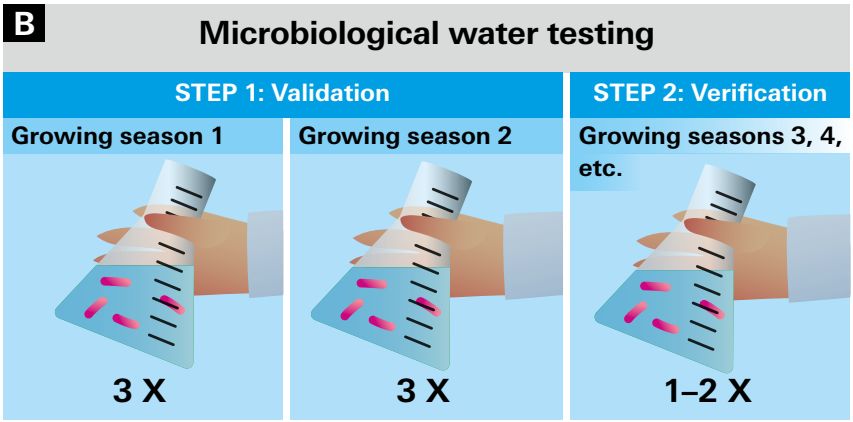
- STEP 1: Validation of the water quality profile by taking at least 6 samples over two growing seasons (3 per season, one just before harvest). This step is not required for water supplied from a municipal source or for on-farm disinfected water.
- STEP 2: Verification of this water quality profile during each following season, by taking one to two samples per season (one for short harvest seasons and two for long harvest seasons).

Table 2 (page 52–53) gives recommendations on microbiological type A water testing frequency, limits and corrective actions in case of deviations (results above the limits) for all water sources, for both validation and verification steps.

A



B



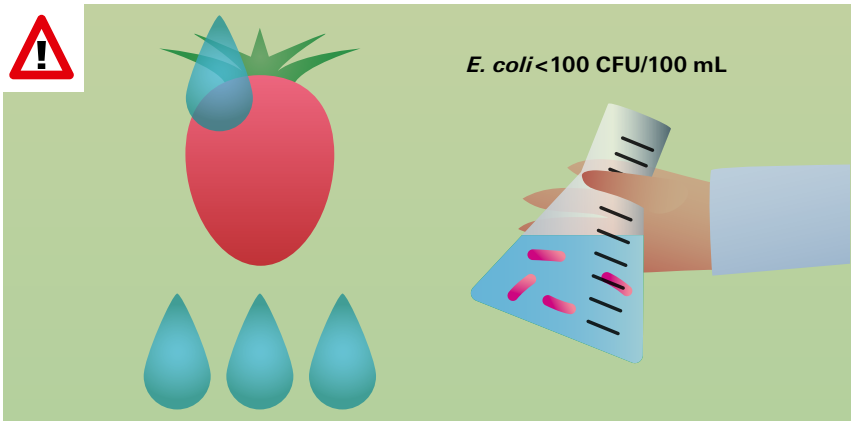
Agricultural water testing

C For type B agricultural water (see page 40), no microbiological testing is required.

However, in the event of an adverse situation where water has come into contact with the harvestable part of the crop, assess immediately the microbiological quality of the water using the same microbiological analysis and limits as for verification of type A water (see Table 2; *E. coli* < 100 CFU/100 mL).

D Water microbiological testing should be performed by a laboratory ISO 17025 accredited for methods of testing or one approved by an official government scheme.

E For municipal water, request or ensure you have access to municipal water system results or certificates of compliance.



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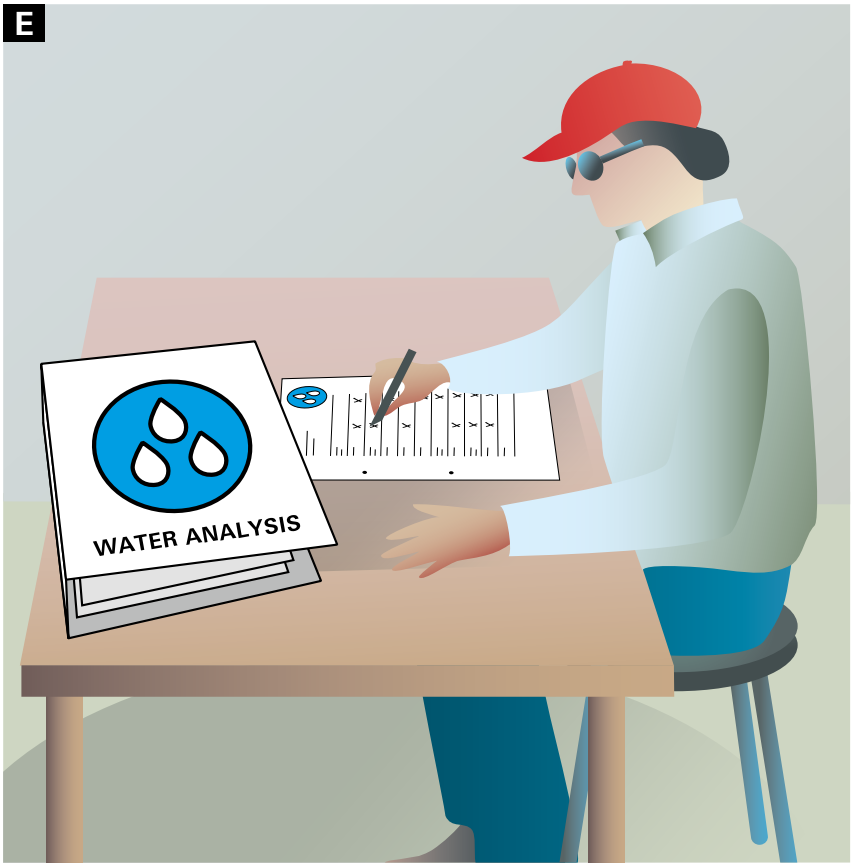

Agricultural water testing

F **Tips to perform good water sampling:**

1. Perform the sampling at the nearest practical sampling point of water application (not on the source itself), e.g. from the sprinkler or at the tap for hand washing etc…
2. Run the irrigation system the amount of time needed to flush the "hold up" volume of the system plus additional 5–10 minutes, before the sample is taken. For distribution system taps, open the tap fully and allow the system to run for at least 10 minutes.
3. Use only sterile containers to collect water (might be provided by the testing laboratory). Do not rinse the sterile containers prior to taking samples.
4. Slowly fill the container and close it tightly.
5. The sample should be delivered to the laboratory as soon as possible after its collection (sent on the day of sampling for a delivery within 24 hours is the best practice) and in a cooler with ice or gel packs during transportation. Check with the laboratory for any additional procedure/ recommendation (e.g. volume to be sent).

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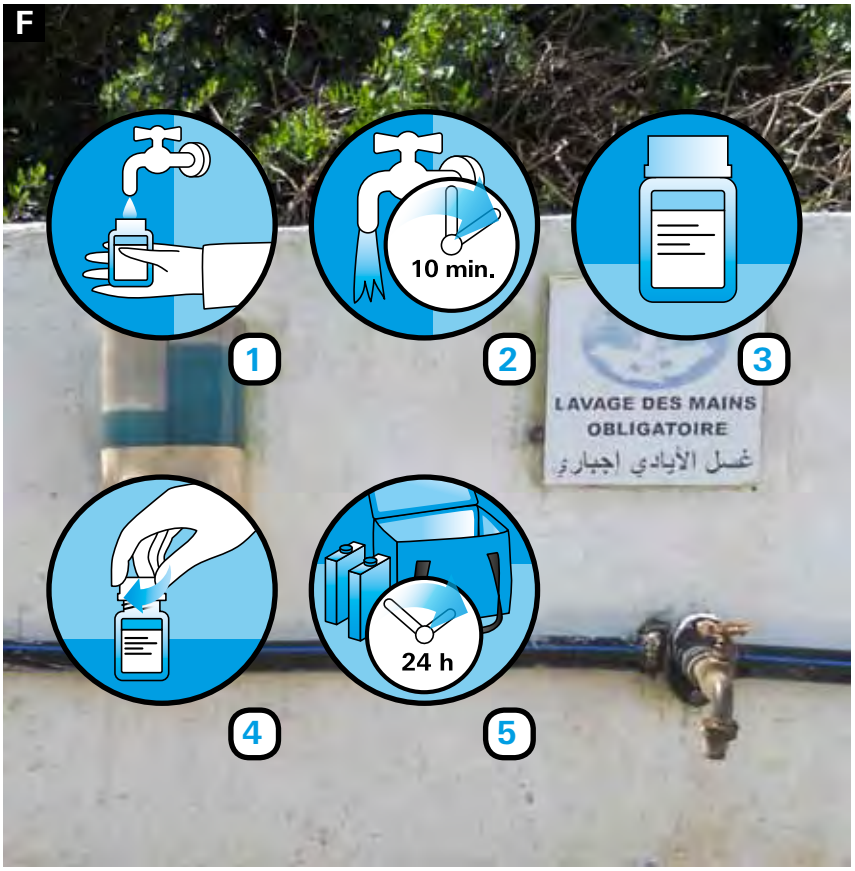

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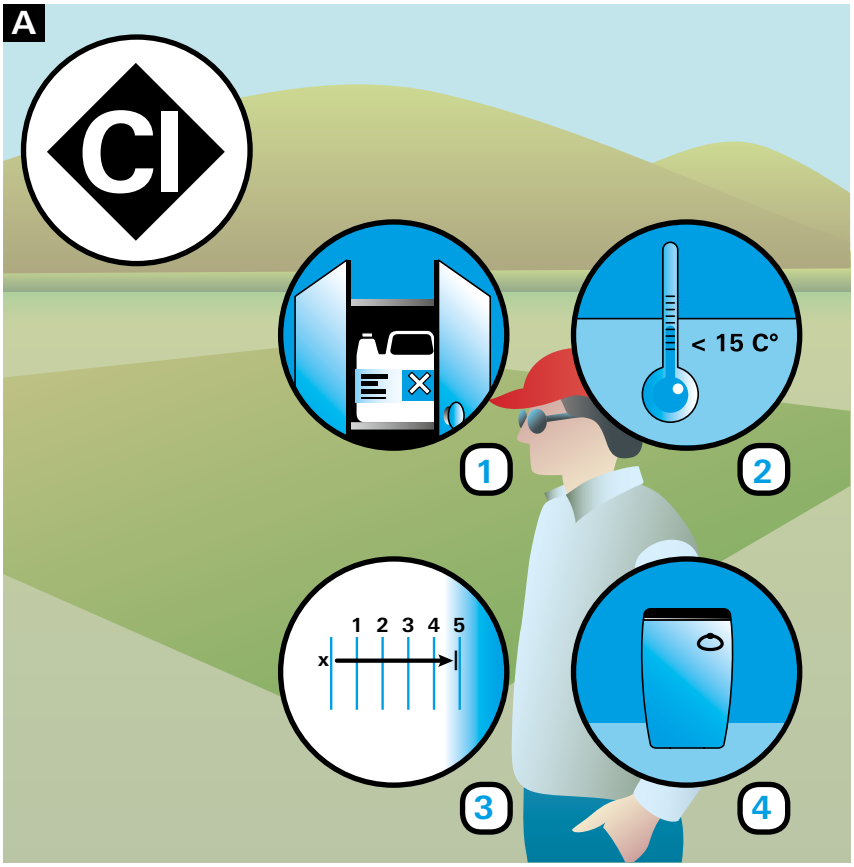
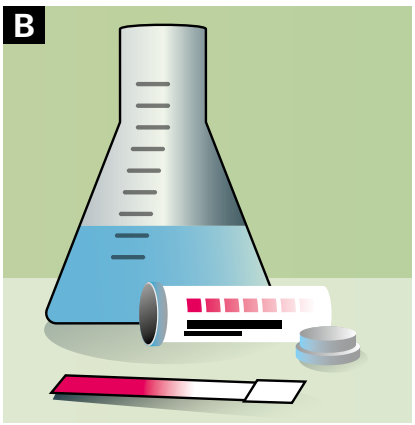
Water disinfection treatments

A If water chlorination is applied, avoid production of degradation products such as chlorite and chlorate by storing hypochlorite:

1. In the dark (dark packaging or dark room);
2. At cool temperature (below 15°C);
3. If possible in a diluted format (e.g. two times dilution of a 13 % bulk hypochlorite solution) and by using it within 5 weeks;
4. In a container made of Teflon, rubber, PVC, PET, plastic (to avoid storage in direct contact with carbon steel or stainless steel).



B If water chlorination is applied, monitor the free chlorine (e.g. once a week) at the nearest practical sampling point of water application using a commercially available chlorine test (e.g. dipstick) to verify that the free chlorine concentration is in the range of 0.2 to 1 ppm.



! Monitor especially after specific events that may have an impact on the microbiological quality of the water (e.g. heavy rain, drought).

Water disinfection treatments

C **When a disinfection treatment is implemented as routine or as part of a corrective action (see Table 2, page 52–53), a competent professional should be consulted. He will ensure type of treatment is fit for purpose and will give guidance on how to apply and monitor it (e.g. free chlorine level). He will advise on the corrective actions in case of deviation (e.g. deviation in the free chlorine level). If you do not know whom to contact, discuss first with your berries purchaser.**

Disinfected water with *E. coli* results above 100 CFU/100 mL should not be used as type A agricultural water and investigation should be performed to find the source of the contamination (see Table 2, page 52–53).