TECHNICAL GUIDE

FiBL

The Organic Cultivation of Bush Berries

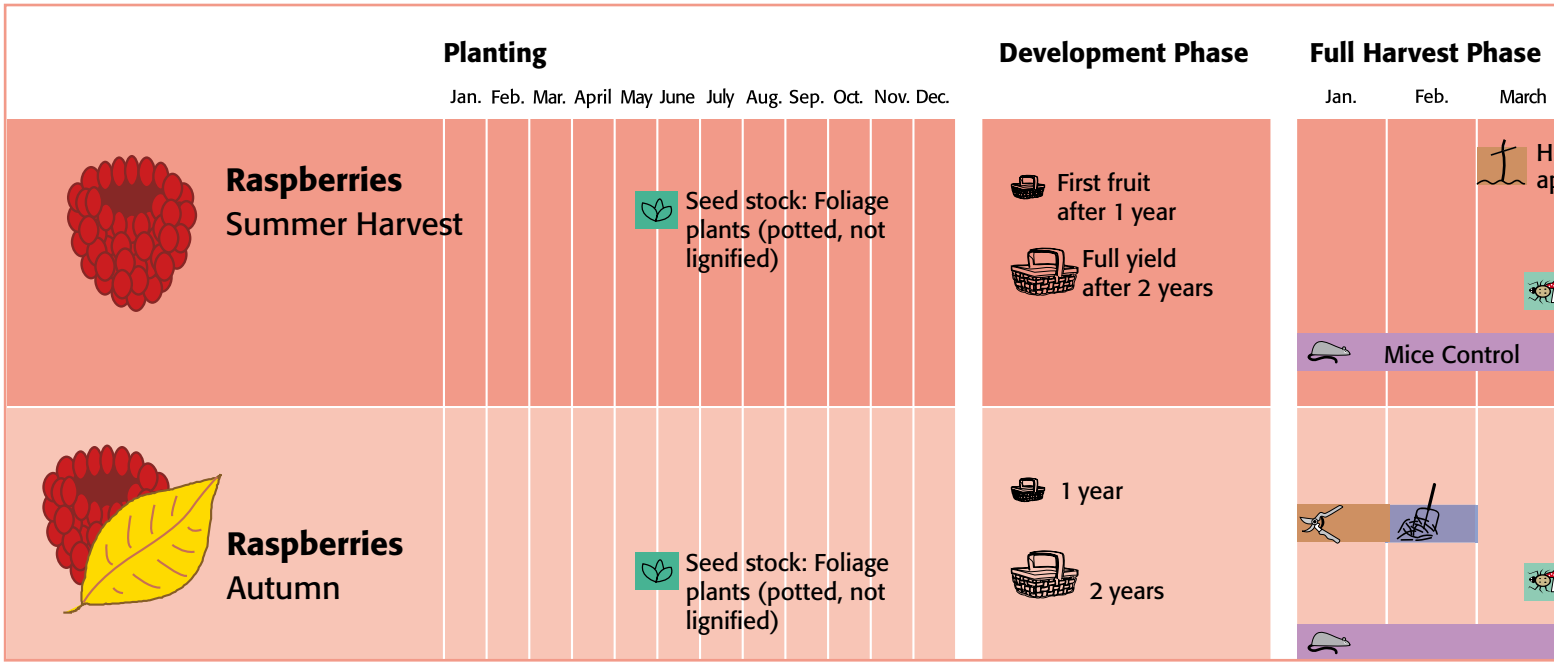
Organic bush berries are in high market demand, and merchandisers and producers are also increasingly interested in high-bush blueberries. This guidebook contains the most up-to-date knowledge on high-bush blueberries. The provided information on the production of high-quality bush berries is practical and clearly laid out. Even though the guide is intended for the professional cultivation of berries, it is also perfectly suited for the cultivation of berries in domestic gardens.

2005, English Translation of the Swiss Version

Made available in English by: OACC Organic Agriculture Centre of Canada

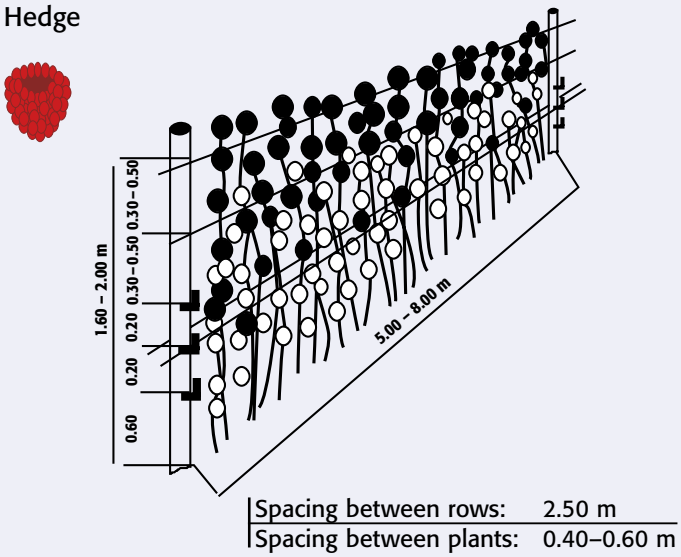
Raspberries

Cultivation Calendar



Training systems

Hedge



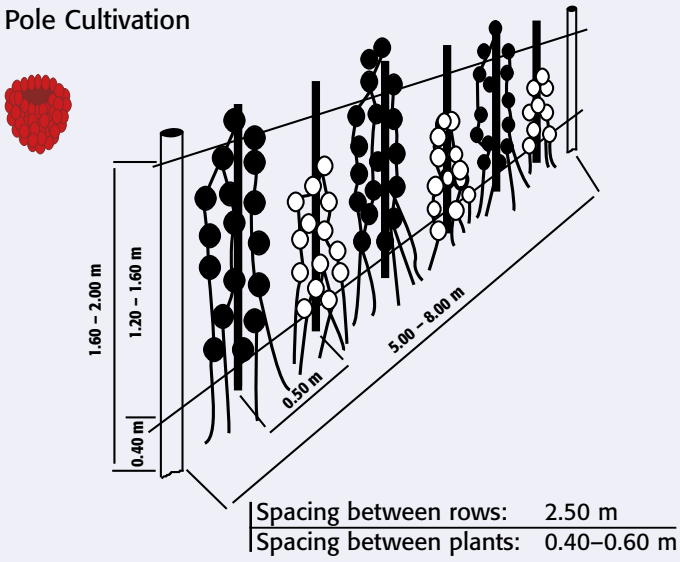
Advantage
- Proven system

Disadvantage
- Attaching canes is not time-efficient.

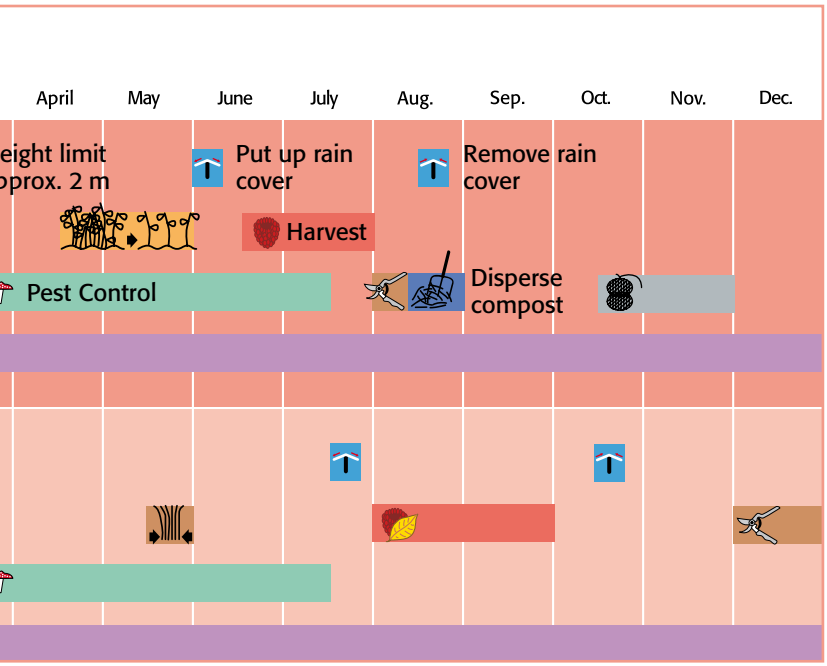
Tips
- The new canes can be pulled through the wire more easily if the lower pair of wires is not mounted firmly.
- Attach fruit-bearing canes with decomposable binding material (suitable for binding pliers) or with multi-use plastic binders.

● **Mature canes**
○ **Young canes**

Pole Cultivation

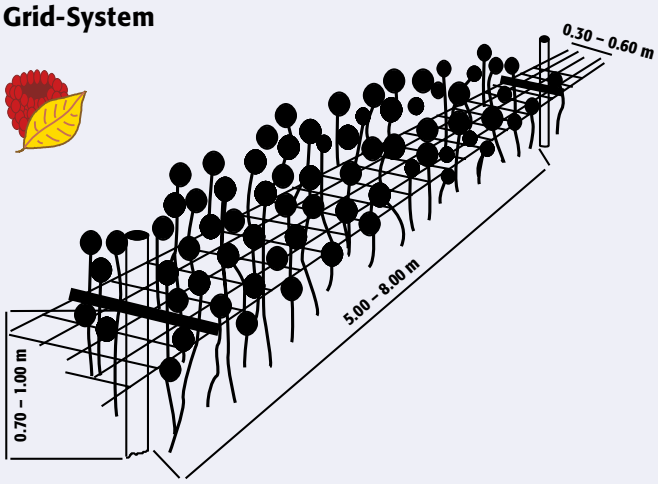


Advantage
- –Attaching canes is time-efficient.



See page 14 for fertilization times.

Grid-System



Spacing between rows:	2.50 m
Spacing between plants:	0.40–0.60 m

Advantage

- Simplest, proven system

Tips

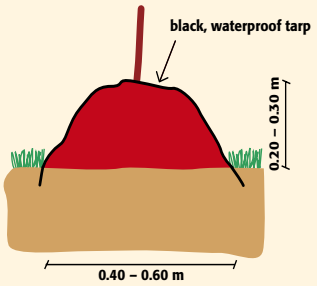
- The fewer canes per metre (ideally 12–20 canes), the sooner the harvest and the bigger the fruit.
- If required, tie up canes with additional strings (from pole to pole). You might actually be able to substitute the entire grid with this method.

You can air out the crop by:

- Thinning out young canes to a total of 10–14 per bush (at medium cane thickness) once they are 15 cm and 50 cm in height. If there are too many young canes each year, tear them off – otherwise cut them off. Prune young canes to approx. 10 cm in length until the beginning of June if your berry variety is growing heavily or if it does not have a lot of canes.
- Weeding the rows of shrubs.
- Mulching the orchard's paths.
- Cutting off mature canes and removing them from the orchard.
- In the case of hedgerow cultivation: Tie up the young canes.
- In the case of pole-based cultivation: Tie the young canes very loosely to the poles if required. Tie the canes permanently and firmly to the poles once the leaves fall off and/or after the canes are lignified.
- Reducing the number of new canes and shrub thickness to 12–20 canes per metre.
- Cutting off all shoots (e.g. by using a power scythe) and removing them from the orchard.

Shrub Row System

Dam



Advantage

- Reduced infestation through dying off of roots *(Phytophthora fragariae)*.

How do you create this system?

1. See page 11 for general soil preparations.
2. Spread 60 litres of ripe and non-steamed plant-based compost per metre onto the future row of plants.
3. Create the dam (by using a special device, plough or simply your hands).
4. Install a drip irrigation system on the dam.
5. Cover the dam with a black, waterproof tarp (facilitates the start phase, limits the growth of weeds and keeps the root area dry (*Phytophthora*-Prophylaxe).
6. Planting. Drill additional holes into the tarp if there are not enough new shoots on the plants.

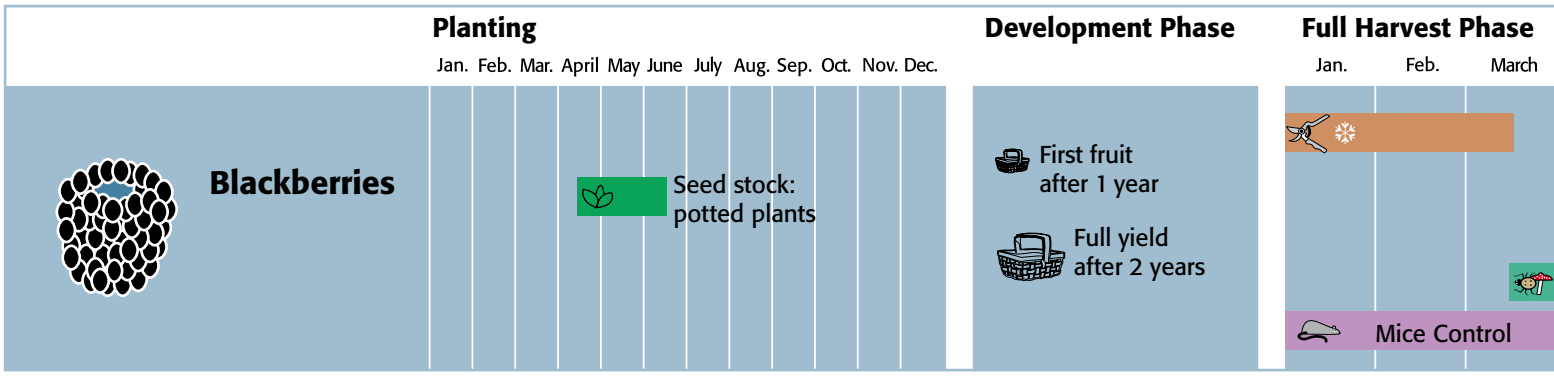
How to look after your plants?

- Spread out 10–30 litres of compost per metre each year (depending on your soil analysis results).
- If the tarp on the dam is no longer intact, remove the non-degradable tarp and hoe it flatly to the left and right of the dam (prevents the growth of weeds on the side). (Variation of the Sandwich System, see page 7).

On light soils, it is also possible to grow plants on the flat ground instead of using the dam system.
Prerequisite: Using *phytophthora*-tolerant varieties.

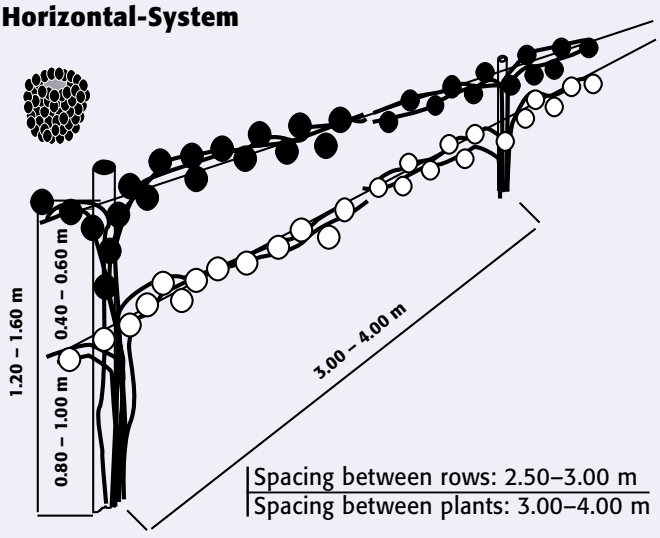
Blackberries

Cultivation Calendar



Training systems

Horizontal-System

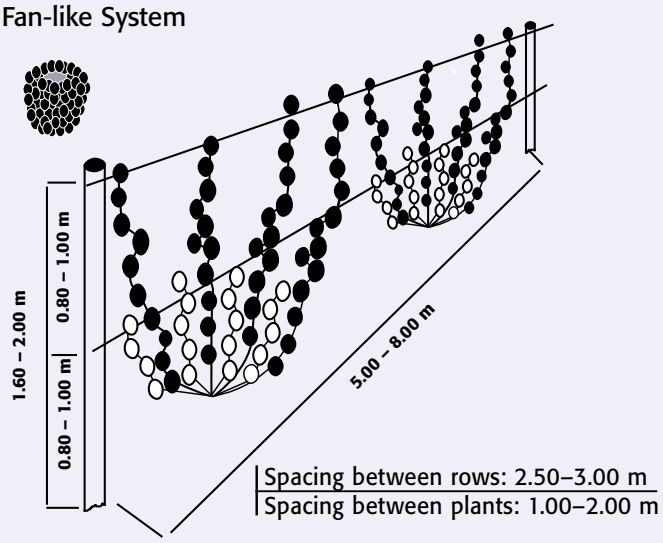


Advantages
- Creating this system is cost-effective
- As an anti-icing measure, canes can be easily taken down in winter.

Disadvantages
- Moderate yield efficiency.
- Moderate size of berries.

Tips
- Only suitable for plants with tendril movement
- Leave 6–8 mature canes per shrub.

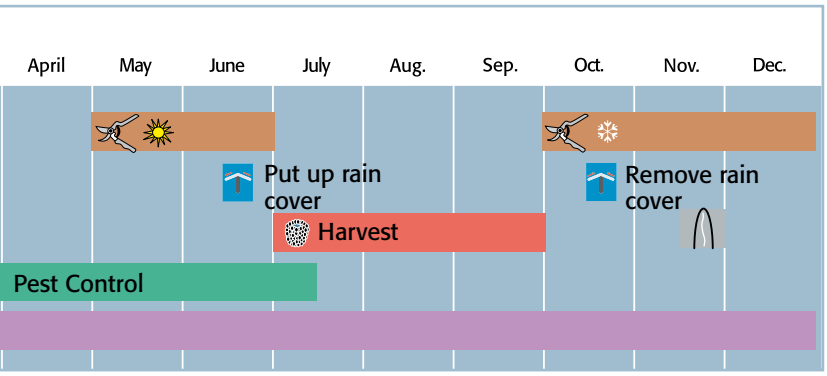
Fan-like System



Advantages
- High yield efficiency.
- Large size of berries.

Tips
- Suitable for upright varieties
- Leave 4–6 mature canes per shrub.

● **Mature canes**
○ **Young canes**

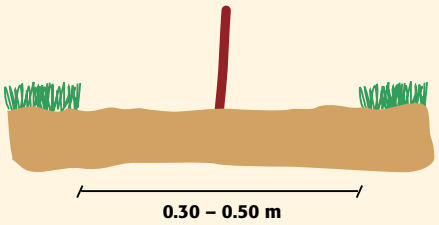


See page 14 for fertilization times.

- Cut mature shoots and excessive lateral shoots and remove them from the plantation. If blackberry mites (see page 21) are a problem immediately after the harvest, and your plantation is located in an area susceptible to frost, do the cutting in March.
- If there are not enough young shoots or if they are too thick, pinch them at a height of approx. 20 cm.
- Cut back any lateral shoots not required for the shrub's structure to a length of 20 cm before the harvest.
- Cover varieties susceptible to frost by placing jute sacks over them or place canes on the ground.

Bush Row Systems

Hoeing

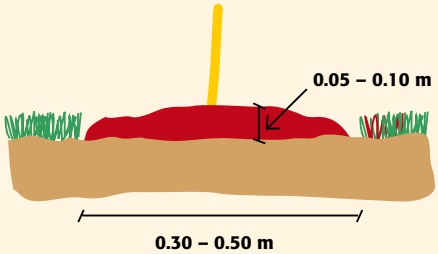


Advantages
- Fertilizer can be added to bush row without any problems.
- Hoeing allows for a proper regulation of nitrogen mineralization.
- Unobstructed mice control is possible.

Disadvantages
- Requires a lot of labour (high fuel consumption, danger of soil compaction).
- Acquiring a hoeing machine with scanning arm technology is only viable on large cultivations or in the case of interplant usage.

Tips
- Hoeing machines with scanning arm: Be cautious with seedlings and young shoots. Pad the scanning arm or protect the stems from being hit (e.g. by using polyethylene pipes).
- If shoots grow sufficiently, allow area to grow over in the second half of the year.

Mulch System



Advantages
- Soil humidity is preserved (can also be a disadvantage).

Disadvantages
- Fertilization might be more difficult if the mulch material is not the actual fertilizer.
- Unbalanced nutrient accumulation (phosphorus and potassium) in a bush row.

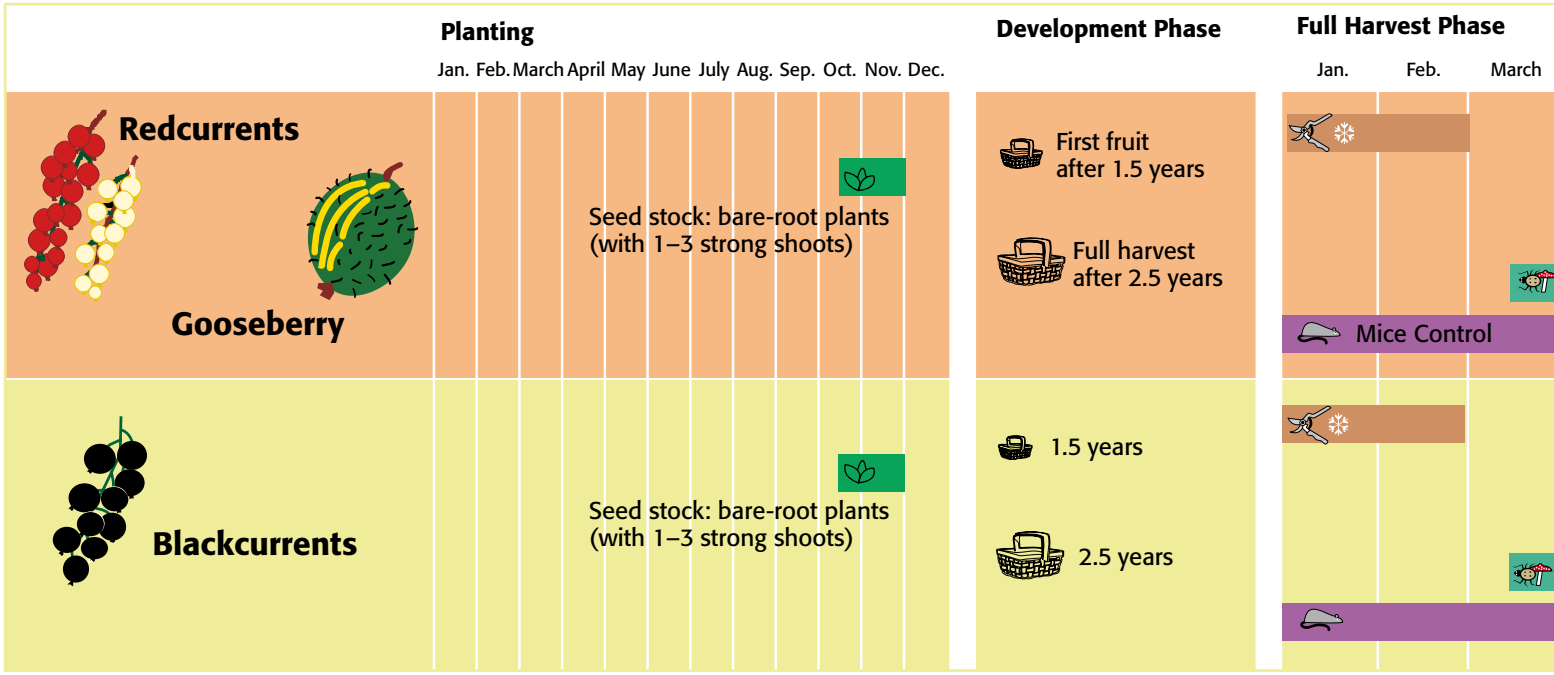
Tips
- Use mulch material specifically customized to nutritional requirements (soil analysis), precipitation and soil conditions: Manure, compost, wheat straw, Chinese silvergrass or bark chips. Use a mulch cover containing bark chips to ensure the most efficient conservation of soil humidity.

Sandwich System

See page 7.

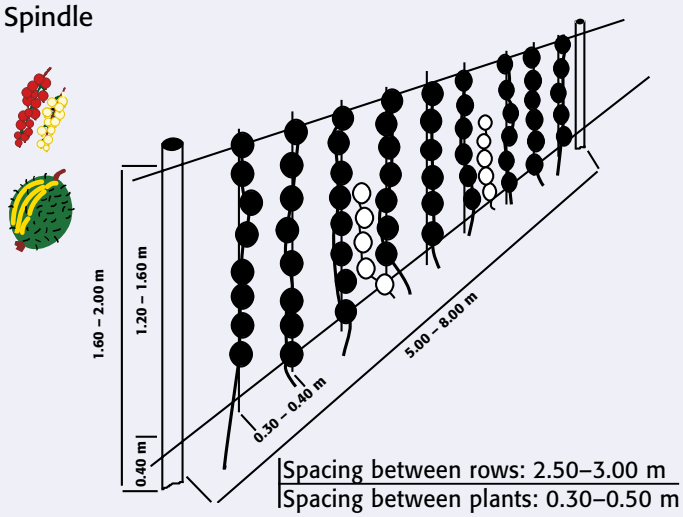
Redcurrents, Gooseberries, Blackcurrants

Cultivation Calendar



Training systems

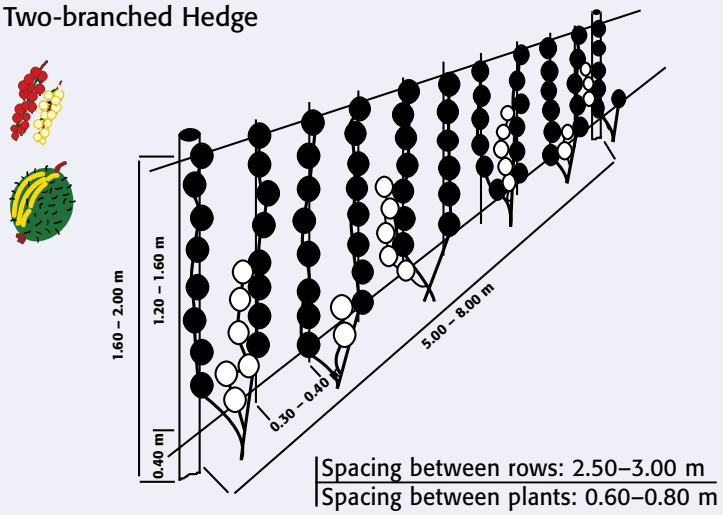
Spindle



Advantages
- Higher picking efficiency than with bush cultivation.
- Height of foliage wall is reached faster than when using the two-branched hedge system.

Disadvantages
- Higher seed stock costs than two-branched hedge cultivation system.

Two-branched Hedge

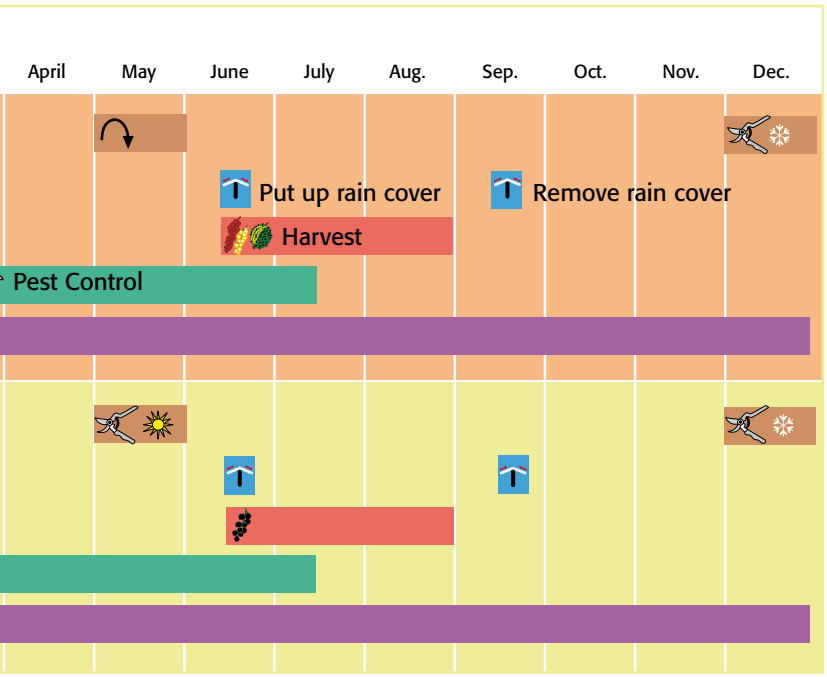


Advantage
- Higher picking efficiency than bush cultivation.

Disadvantage
- Higher construction-related costs than bush cultivation.

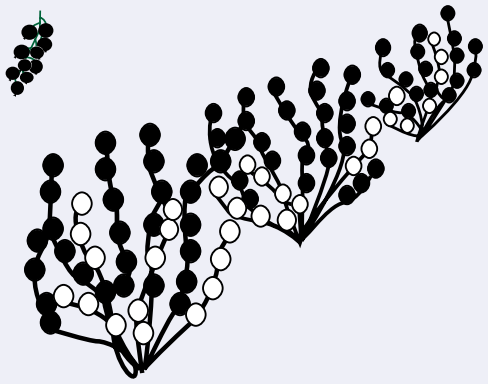
Tips
- Suitable for high growth plant species and varieties.
- Pull up a young cane at each third to fourth fruit-bearing cane; as soon as the young cane starts bearing fruit, remove the old cane.

● **Main mature canes**
○ **Young canes**



See page 14 for fertilization times.

Bush



Spacing between rows: 2.50–3.00 m
Spacing between plants: 1.00–1.30 m

Advantage

- Heavier growth of canes compared to spindle and two-branched hedges.

Tip

- Plant deeply to achieve sufficient growth of canes.

Slightly twist upright lateral shoots that are too thick (increases the fertility).

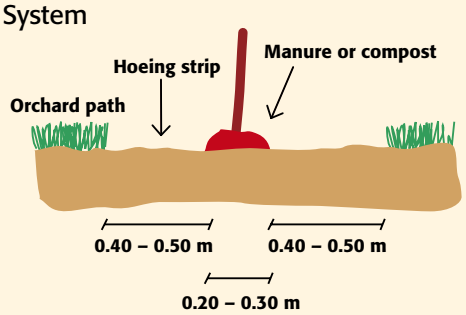
- Cut back lateral shoots that have been harvested once as well as lateral shoots that are not needed or too thick to a length of 2 cm; pay attention to the specific properties of certain varieties (see variety list by FiBL).
- Depending on the aging process of the main canes, replace the main canes with young canes growing from the cane base every couple of years.
- Remove all spurs.
- Remove any cut plant material from the orchard if Colletotrichum (see page 22) is a problem. Otherwise, chaff and/or mulch the material for fast decomposition.
- Remove all canes growing from the base except for 3 to 4 strong, upright canes required for the bush structure.
- Trim all main canes that have been harvested twice to 40 cm long butts.

Work to do during the development phase:

- Reduce the number of canes to 1 (in the case of a spindle) or 2 (in the case of a 2-branched hedge).
- Remove all lateral shoots up to 50 cm above the ground and snap off any competing shoots (possibly pinching).
- Continually tie the main canes to the wire.
- Remove flowers in the first vegetation period.
- Remove flowers in the first vegetation period.

Bush Row Systems

Sandwich System



Advantages

- Advantages of hoeing method are combined with advantages of mulch system (see page 5).
- Application of cost-efficient hoeing machines (without scanning arm) is possible.
- Higher operating speed than hoeing method.

Disadvantage

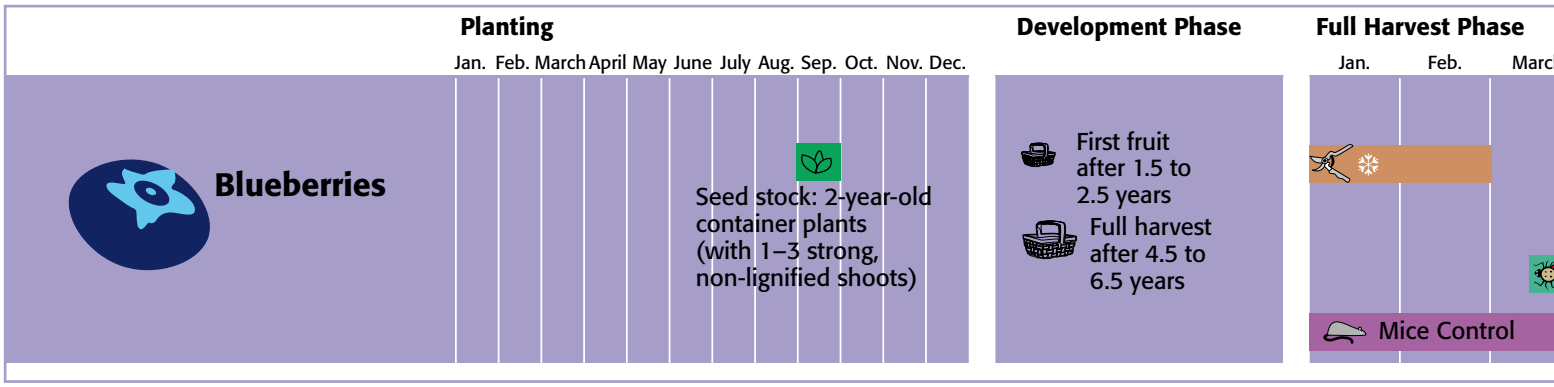
- New system – as a result, there is not a lot of practical information available.

Hoeing
See page 5.

Mulch-System
See page 5.

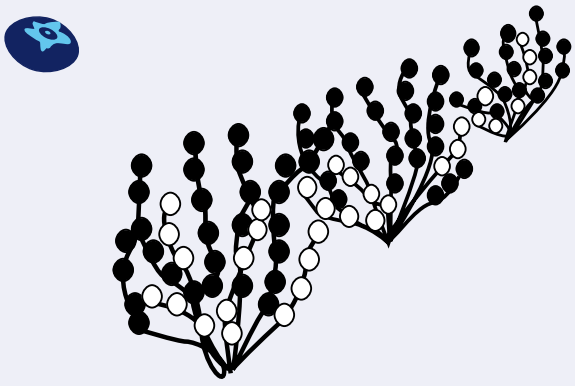
Blueberries

Cultivation Calendar



Training systems

Bush



Spacing between rows: 2.50–3.00 m
Spacing between plants: 1.00–1.50 m

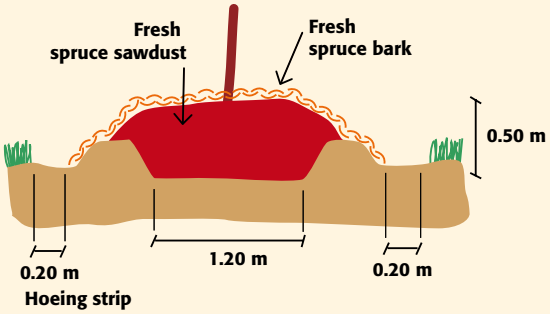
Tips

- Heavy winter pruning has a positive impact on the vegetative growth and fruit size.
- The pruning of developing young canes stimulates branching and reduces longitudinal growth (which is rarely desirable).

● **Fruit-bearing branches**
○ **Young branches**

«Fricker» System

→ Without turf* – Ditch & Dyke – Sulphur – Bark – Grassed over orchard path



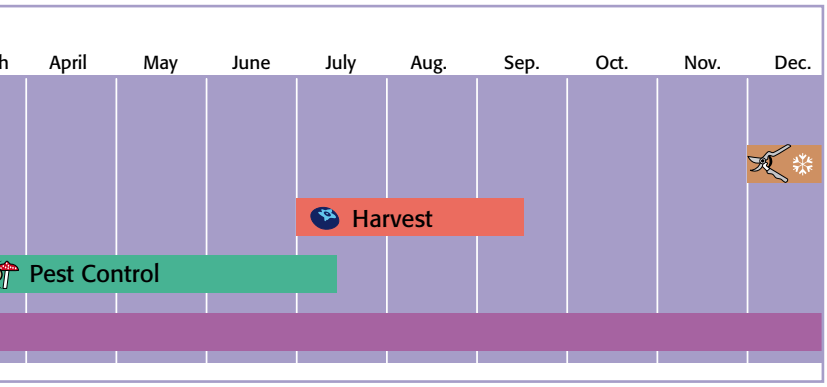
Advantages of «Fricker» System

- Creating root conditions suitable for blueberries without having to use peat and plastic tarps
- Grassing over of orchard path is possible.

Important:

- All previous applications of the «Fricker» system have been positive; however, they are all based on a trial running since 1998 and therefore not broadly verified.

* The Swiss BIO SUISSE regulations prohibit the use of peat in blueberry cultivations. It is also prohibited to entirely separate the root area (e.g. by using a plastic tarp) from the natural, already-existing soil (e.g. as cultures in sacks).



See page 14 for fertilization times

- To obtain larger fruit sizes (and increased picking efficiency) as well as sufficiently strong vegetative growth, remove superfluous elements such as one-time fruit-bearing cane tips, barked-up canes, canes bending to the ground during the ripening phase and surplus flower buds (upper shoot area).
- Remove pruned plant material from the orchard to prevent disease transmission (*Colletotrichum,* see page 22).

Things to do during the development phase (after approx. 2 years):
To increase the vegetative growth:
- Remove weak or horizontal shoots and prune all flower buds (upper section of one-year-old shoots). Time: December to February.
- Apply nitrogen fertilizer depending on growth and foliage conditions (see pages 14 and 15).

How to create this training system?

1. 1. Free area from root weeds, in particular couch grass (*Agropyron* sp.) and mice.
2. Create a 20–30 cm deep ditch using a double-share plough; dig once to the left and once to the right (goal: ditch of approximately 1.20 m in width).
3. Shovel out any soil that fell back into the ditch if necessary.
4. Fill ditch will fresh spruce sawdust (no sawdust from deciduous trees or chaff from shrubs!) to create a slightly cambered bed (see illustration on the left). The sawdust should be soaked with rainwater before the planting in September.
   Required sawdust for 1000 m²: approx. 200 m³.
5. To decrease pH levels, apply 60 g of elemental sulphur evenly onto each metre of sawdust and work it in lightly approximately 4 weeks before planting.
6. Cover the sawdust with a 5 cm thick layer of spruce bark (without soil parts!). Required bark for 1000 m²: approx. 20 m³.
7. Sow the seeds on the orchard path (in spring).

The «colourful» option
- Sow the seeds of wild flowers best suited for your location. Choose a mixture that contains no subterranean runners which might be difficult to remove e.g. coltsfoot/coughwort *(Tussilago farfara)*.
- Advantage compared to the «green» version (see below):
  - Improves the biological diversity e.g. increased number of beneficial, flower-visiting animals.
  - Increases the willingness of buyers to buy high-bush blue berries.
  - The cut plant material can be used as fodder.
- Disadvantages compared to «green» option:
  - Requires more work (removal of cut plant material, increased danger of weeds growing in a bush row).

The «green» option
- Spreading mulch mixture.


Andi Schmid

By sowing a mixture of wild flower seeds on the orchard path, a «colourful» blueberry orchard can be created. The bush row displayed in the image has not been yet been covered with bark.

How to look after the cultivation?

Bush rows
- Starting with the summer following the creation of the rows, measure the pH level (of the sawdust cover only!) each year at the same time. If the pH value is too high (see pages 10 and 11), apply 20–40 g of elemental sulphur per metre.
  Caution: It will take a couple of weeks for the pH level decrease to take effect. Do not apply additional sulphur as this could result in a drastic pH level decrease and harm your plants.
- Depending on the decomposition level of the sawdust, apply fresh spruce sawdust (approx. 10 cm tick layers) after a couple of years and cover the layers with spruce bark.

Orchard path
- Create a hoeing strip (20 cm in width) between the orchard path vegetation and the sawdust (prevents weeds from crossing over into the bush row).

«Colourful» version
- Trim twice a year and remove cut plant material (in agricultural zones, first cut from June 15th onwards).

«Green» version
- Mulch regularly.

Creating a Bush Berry Orchard

Planning

Creating a bush berry plot is work-intensive and expensive. Therefore, it is advisable to clarify any concerns and do extensive planning beforehand.

The 3 core questions to be answered before entering this sector are:

- ***Are bush berries suitable for your operation?***

The work-intensive cultivation of berries is not for everyone. Even subtleties can make the difference between success or failure. The cultivation of berries requires expert knowledge and sensitivity.

In order to produce high quality berries profitably, the orchard has to be in a suitable location (see information on the right). It also has to be clarified early on whether operational peak times (see page 27) can be handled.

- ***Is there a demand for bush berries?***

Before carrying out the planting, any marketing concerns should be clarified and dealt with. Depending on the geographic location of the orchard, your available workforce and your personal inclinations, you will have the option between direct sales and selling at wholesale.

- ***Which intensity level should be aimed at?***

Due to the growing quality demands of buyers, the professional cultivation of berries is becoming increasingly cost-intensive (e.g. weather protection, see page 16). Consequently, there is more pressure to achieve high yields on a regular basis. Extensive berry cultivation is better suited for direct sales or further processing (see page 28).

Selecting a location

Exposure

Sunny and airy locations, protected from strong winds and late frost, are most suited for all varieties of bush berries. To ensure adequate sun exposure, the rows should be laid out in north-south alignment. Rows in alignment with the main wind direction will dry faster and are consequently less prone to diseases.

Soil Quality

- Bush berries are very demanding
- Cultivate on medium-heavy to light, permeable soils only.
- Areas with soil compactions or water logging are not suitable. Low yields and root diseases are prone to happen on unfavourable soils.

Andi Schmid

Unlike creosote timber (right), non-impregnated robinia poles (left) do not cause any plant burns (pay attention to the growth of grass between the poles).

Separated by a path: The same soil treated appropriately (left) …

Ecological Buffer Zones and Auxiliary Supplies

It is the aim of the organic agricultural sector to act ecologically responsible and exemplary. To ensure that an organic cultivation is also visually recognizable as such, ecological buffer zones should be an inherent part of each orchard.

It is equally important to select the appropriate auxiliary supplies. It is not very useful, for instance, to limit the application of copper as a pesticide treatment if there is a significant amount of copper leaching into the soil due to the degradation of CCB-impregnated poles.

The FiBL guide «Creating a Dwarf-Tree Orchard» explains how semi-natural habitats can be integrated in orchards; it also provides information about problematic substances and their alternatives.

Preparatory Cultures

The further apart the botanical relationship between the preparatory crop and the planted berry variety, the smaller the risk of pest transmission. A one or two-year catch crop (e.g. wild radish *(Raphanus)*, artificial meadow with alfalfa *(Medicago)* or other deep-rooted plants) improves the structure of even the lower soil layers.

Cultivating on a previously natural meadow generally leads to increased weed growth and infestations by wireworms *(Elateridae)*.

Selecting the berry variety

Important selection criteria are:

- High internal quality of fruit
- High pest resistance
- High yield reliability

Creating plots on compost-enriched dykes minimizes root disease problems and is currently the standard cultivation method on medium-heavy to light soils (see page 3).

- Plants have somewhat lower soil demands.

- Require light, acidic soils rich in humus (pH (H_2O method) at approx. 4.0).

Soils of this kind are rarely found in Switzerland; however, it is still possible to cultivate blueberries by using special bush row systems (see pages 8 and 9).

You should always perform a spade test to evaluate your soil and select the proper location.

The spade test – What to look out for?

- Use drainage spades if possible.
- Dig at least 40 cm into the soil.
- Rusty spots and black manganese concretions indicate aeration problems and therefore problematic soils (soils of this kind are entirely unsuitable for blueberry cultivation without dykes!).

Altitude

Depending on exposure conditions, each altitude difference of 100 m can lead to a harvest delay of 3 to 5 days. The fruit might only ripen partially depending on altitude and variety.

- Varieties sensitive to frost are not suitable for cultivation at higher altitudes.
- The plants need to be protected from snow pressure by using particularly sturdy training systems and/or by tying the bushes together.

Cultivation up to approx. 1400 m above sea level,

up to 1000 m above sea level, depending on exposure conditions.

and inappropriately (right). (Pay attention to the soil structure.)

Cultivation of autumn raspberries in higher altitudes.

Soil Preparation and Planting

The soil should not be too wet, dry or frozen when tilling or planting. Large amounts of non-decomposed manure, green plant material or straw should not be added to the soil since they may inhibit growth.

You can prevent furrows by using spading machines or rototillers. If the soil already has furrows or other compactions, the tilling should reach 3–5 cm below these zones.

If the soil is well structured, a tilling depth of 10–15 cm will be sufficient.

Please refer to pages 3 and 8 for crop-specific soil preparation and planting information.

General Pest Management

Preventative pest management plays an important role in organic farming. It is very important to select the appropriate location, training system, preparatory crops, variety and planting stock as well as the proper tilling and fertilization method.

To prevent the introduction of pests in your orchard, random samples of dubious plant material may be sent for testing (applies mainly to raspberries with suspected Phytophthora root rot).

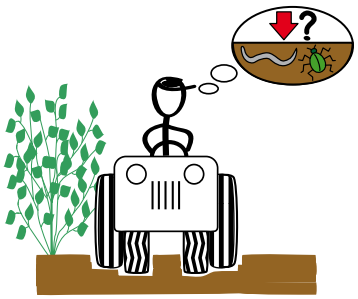
For detailed information on pest management measures refer to pages 18 to 26.

Application Technology

For small areas or spot treatments, pesticides should be applied with hand-operated or motorized backpack sprayers. For larger areas (more than 1.5 acres), air blast sprayers should be used. Pesticide mixtures at basic concentrations should be applied at a ratio of 500 to 1300 litres per hectare (1 ha = 2.47 acres) depending on the crop and developmental stage. The air blast of the sprayer has to be adjusted according to the respective crop. It is advisable to double-check the spray properties with water-sensitive paper.

Four steps to an optimum nutrient supply

Adjusting cultivation methods to use already existing nutrients more efficiently



How?	Why?
■ Adjust the bush row cultivation to the nutritional conditions of the berry plants.	Because already existing nutrients will be used more efficiently
■ Use virus-free plant material.	Because it generally grows better and requires less nitrogen.
■ Only cultivate the soil under optimum conditions ■ Use gentle hoeing machines and/or cutters instead of PTO-powered units. ■ Use light machinery with low pressure tires.	Because nutrients are more accessible to plants in gently cultivated and well structured soils.

Performing soil analyses

When should the soil samples be taken?

■ In fruit-bearing orchards, soil samples should be taken every 5 years in autumn.
In new orchards, soil samples should be taken before planting.
N_{min} immediately before the fertilization.

How should the soil samples be obtained?

■ Use a soil sampler to obtain at least 20 soil samples per lot unit of the soil zones containing berry roots i.e. also take samples from the bush row and the orchard path edges and, depending on the distribution of roots, also from the actual orchard path. Sample depth: 0–30 cm, without turf.

Only take samples from the strip of sawdust. Even the smallest trace of natural, pre-existing soil (e.g. if the sample was taken from too far down) can significantly falsify the analysis results (especially the pH value).

Which analysis programs should you use?

■ Minimum option:
pH (H_2O), humus content, nutrient reserves of P_2O_5, K_2O, Ca, Mg.

■ Optimum option (especially recommended if you intend on performing new plantings or if there are nutritional disturbances):
pH (H_2O), humus content, nutritional reserves and highly soluble nutrients from P_2O_5, K_2O, Ca, Mg.

■ N_{min} (if an oversupply or undersupply of N is suspected):
Only have the pH (H_2O) value measured. Nutrient analyses are not really useful at the moment since an interpretation of the results will be difficult due to the new training system.

Important:
To ensure that the contracted soil laboratory is able to calculate the amounts of nutrients to be applied (see pages 13 and 14 for further information on nitrogen), you will need to provide the name of the berry variety and potential yield on the accompanying form.

Fertilizing berry crops – What do the guidelines of the Swiss BIO SUISSE-Label suggest?

1. **Nutrient Balance**
   It is necessary to calculate the nutrient balance based on the «Suisse Balance» method if
   - fertilizers containing N and P are applied on farms without animals

   or if
   - there are more than 3 pigs and 20 laying hens on the farm

   or if
   - the proportion of extensively or less intensely farmed fields exceeds 30 % and the animal stocking per hectare of fertilizable area exceeds the following values: Agricultural and transition zone 1.7, hills zone 1.4, mountainous zone I 1.2, mountainous zone II 1.0, mountainous zones III and IV 0.8.
   - The nutrient calculation must be balanced.
2. **Time Period for Calculation**
   P_2O_5 can be applied as compost and lime in form of a 3-year-application and can therefore be calculated for a three-year period.
3. **Soil Analysis**
   In Switzerland, a soil analysis has to be performed by an authorized laboratory at least every ten years in order to comply with ecological efficiency regulations (ÖLN). See page 12 for recommendations.
4. **Maximum Nutrient Supply**
   The average maximum nutrient supply for fertilizable prime areas (agricultural and transition zone) amounts to 135 kg of N_{sol} and 87.5 kg of P_2O_5 per hectare and year. Note: These values do not comply with the recommendations. See page 14 for recommendations.
5. **The Application of Farm Manure**
   Only apply manure from organic farms if possible. If this is not possible, at least half of the manure should originate from organic farms. The application of non-organic farm manure is regulated. Maximum driving distance to the supplier of farm manure: 20 km for liquid manure from cattle, horses and pigs. 80 km for chicken and mushroom manure as well as compost.
6. **Quality and Quantity of Compost and Sewage Sludge**
   The heavy metal content of the applied compost may not exceed the defined legal limits. Within a time period of three years, a maximum amount of 25 tonnes of compost (dry substance) per hectare may be applied. The application of sewage sludge is prohibited.
7. **Commercially Available Fertilizer**
   Only commercial products mentioned in the «List of Auxiliary Supplies» published by FiBL are allowed.
8. **Potash Fertilization**
   Potash Sulphate, Patentkali (= potash magnesia) and Magnesia Kainit may only be applied if a soil analysis has been performed (by an authorized laboratory and not more than four years ago). In supply category A, a maximum of 75 %, in supply category B, a maximum of 50 %, and in supply category C, a maximum of 25 % of the nutrient requirements may be supplied by applying the above mentioned products.
9. **Foliage fertilizer containing highly soluble trace elements, Ca and Mg**
   The use of fertilizers containing highly soluble trace elements, Ca and Mg has to be registered (Organic Farming Control Authority), and the following conditions apply:
   - It has to be proven that the fertilizer is required. The following counts as proof of that requirement: Soil or plant analyses (by an authorized laboratory and performed not more than four years ago), visible deficiency symptoms or regularly occurring losses (e.g. bitter pit on apples).
   - There has to be a designated control area (no fertilizer treatment).
   - The fertilization results have to be documented.

Visual Inspection

Visual Inspection
You can draw valuable conclusions about the nutrient requirements of your bushes by visually inspecting their condition (colour and size of foliage as well as shoot growth). This procedure is particularly important to evaluate nitrogen and trace element requirements; all other nutrient deficiencies are generally detected through soil analyses.

The nitrogen supply needs to be increased under the following conditions:
- Heavy fruit bearing.
- Insufficient shoot growth.
- If the leaves change colour from dark green to light green or yellow and/or if the leaf size is below average.

Even if there are signs of a nitrogen deficiency, there is no need to apply fertilizer immediately.
- Because the nitrogen supply can be improved by simply hoeing the bush row.
- Because during periods of drought, watering might have a bigger impact.
- Because low soil temperature and increased moisture levels can result in temporary deficiencies even though the overall nitrogen level might actually be high.

Applying fertilizer as required

How much fertilizer?

- N: Take previous observations and experience into account (see point C); it might be useful to perform a soil analysis assessing Nmin levels before applying any fertilizer. Required N supply (Nmin concentration in soil + fertilizer): 45 kg per hectare and per year, 55 kg per hectare and per year, 85 kg per hectare and per year, 70 kg per hectare and per year, 60 kg per hectare and per year.
  Caution: Excessive nitrogen levels will lead to heavy vegetative growth, increased pest infestation, a decrease in yield and fruit quality as well as increased expenditure and ground water pollution.

- P_2O_5, K_2O, Ca, Mg and trace elements if required: Apply fertilizer according to the nutrient requirements calculated by the laboratory.

m■ N: Take previous observations and experience into account (see point C). During the initial two years, the amount of required N will be increased due to the unfavourable C:N ratio in the sawdust; it amounts to approximately 60 kg per hectare and per year. During the yield phase, approximately 30–60 kg of N are required per hectare and per year.

- P_2O_5, K_2O, Ca, Mg and trace elements if required: Based on previous experience, these nutrients are already largely available to plants due to the decomposition of applied sawdust and/or bark.

The nutrient quantity recommended by the laboratory should be applied annually until the next soil analysis is performed. See «Fertilizing berry crops – What do the guidelines of BIO SUISSE suggest?» (page 13, point 2) for further information on exceptions.

Where should you apply the fertilizer?

Nitrogen-containing fertilizers are usually applied to the bush row area only in order to prevent excessive vegetative growth on the orchard path. All other fertilizers can be applied to the entire sampled area.

When should you apply the fertilizer?

N-containing commercial fertilizer:
From the time the first shoots appear until May (possibly June), depending on the condition of the plants and the time it takes for the fertilizer to take effect.

Organic N-containing liquid fertilizer should be added in two or three applications per year during the development phase.

Compost, manure and liquid manure:
See table below.

All other fertilizers:
From February to the middle of March (while the shrubs have no foliage). Not on frozen or heavily drenched soils.

Nutrient content of compost, manure and liquid manure (in kg per m^3 of fresh matter) **and their optimal application time**

	Nutrient Content						Optimum
	N_{total}	$N_{available}$ *	P_2O_5	K_2O	Mg	Ca	Application Time (see below)
Compost (1 m³ ~ 500 kg)	3.5	0.2	2.0	2.85	1.55	14.0	February – Middle of April Exeptions: After removal of fruit-bearing canes in summer
Heaped Manure (1 m³ ~ 700 kg)	3.4	0.7	2.2	4.6	0.6	2.6	Middle of March – Middle of April
Mushroom manure (1 m³ ~ 500 kg)	3.5	1.5	2.5	4.0	1.5	2.7	Middle of March – Middle of April
Cattle Liquid Manure	4.3	2.2	1.8	8.0	0.5	2.0	April – May

* relevant for requirements

The numbers in this table are average nutrient contents. In reality the contents can differ creatly.

Which fertilizer?
To improve and/or maintain a proper soil structure with high biological activity, you should always apply organic fertilizers if possible.

Humus
Chose a fertilizer with a high content of organic matter (compost, farm manure, organic mulch material) – particularly if the humus content is below 2.5 %.

Nitrogen (N)
Organic commercial fertilizers, farm manure and compost (take content of other nutrients into account – see table on page 14).

Phosphorus (P_2O_5)
Compost and farm manure. Mineral P-fertilizer (apply medium to deeply into the soil).

Potash (K_2O)
Compost, farm manure, organic mulch material, multi-nutrient fertilizer and rock powder rich in K). Also see page 13, point 8.

Calcium (Ca)
Compost. Different lime fertilizers (monitor impact on pH level).

Magnesium (Mg)
Compost, farm manure, organic mulch material. Rock powder and algae products (monitor impact on pH level).

Trace elements
There are many different commercial products available to deal with trace element deficiencies. See page 13, point 9, for further information on their application.

pH value
pH levels can be increased by applying lime fertilizer (see section on «Calcium»). For information on decreasing pH levels, see section on blueberries, pages 8 to 9.

Use acidic or neutralizing commercial fertilizers. During the development phase, you should apply organic N-containing liquid fertilizer if possible. Compost and farm manure are not suitable due to their pH-increasing properties.

Andi Schmid

Watering young blueberry crop by using microjet irrigation

Microjet irrigator in action

Irrigation

The water demand is highest during the fruit development stage. The supply of sufficient water during this time period will have a direct impact on the fruit size and yield. When cultivating berries, micro-irrigation systems are preferred to overhead irrigation systems because they require less water, keep the fruit drier and the orchard more accessible.

In the case of **raspberry** orchards, the irrigation of rain-protected cultivations on dykes is a must. After the harvest and/or once young shoots have reached the desired height, the cultivation should only be irrigated under exceptional circumstances in order to prevent root rot (*Phytophthora*).

Currant, black currant and **gooseberry** bushes will reach their optimum height faster if irrigated.

Blueberries are very sensitive to dryness due to their shallow root system.

To ensure an even water distribution to the root system, micro-irrigation (microjet) systems should be used instead of sprinkler irrigation systems. Microjet systems are more expensive, however, and they require more care since they are more prone to breakdowns.

If irrigation is not an option, the plant beds should be at least covered with spruce bark (see pages 8 and 9). The bark will significantly reduce the water loss through evaporation and promote plant growth.

In the year 2000, FiBL started to research the impact of the quality of irrigation water on pH levels of the soil and on plant growth.

Weather Protection

The cultivation of plants under rain covers has a number of general advantages:

- Prevention of yield loss due to weather conditions (bursting, damage to fruit epidermis) and protection from different diseases.
- Fruit does not perish as fast.
- Continuous harvesting is possible (big advantage if selling wholesale or direct).

Crop-specific advantages:

- Fewer incidences of grey mould and shoot diseases (see pages 18 and 20).
- Higher yields because harvesting is possible until autumn.
- Fewer incidences of blight *(Colletotrichum)* (see page 22).
- Harvesting can be postponed (can be very important, depending on the market situation).

Not extensively researched in Switzerland (reduction in *Colletotrichum* infestation possible) (see page 22).

Disadvantages of rain covers are the relatively high resource and energy expenditure required for their manufacturing, their adverse impact on the natural scenery as well as an increased occurrence of spider mites (e.g. in raspberry crops). If plants are covered, it is generally necessary to install an irrigation system.

Weather Protection Requirements:

- Cost-effectiveness has to be ensured. The efficiency depends on the revenue obtained through the culture and on annual costs (take amortization periods into consideration).

Andi Schmid

Wood instead of galvanized metal: «Open-space» weather protection (prototype)

Exemplary: Weedless row of raspberry bushes in spring

Weed Control

In **raspberry** crops, the bush rows should be free of weeds at least from the time the young canes emerge to the harvest end to reduce the competition for water and nutrients (important for the development of fruit and young shoots) as well as to prevent cane diseases (see page 18).

You can remove weeds at the same time as you thin out young canes (see pages 2 to 3).

Of all bush berries, **blackberries** are the least sensitive to weeds.

Removing weeds in the cane area might be sufficient in the case of heavily growing varieties and if there are large distances between the plants. In all other cases, weed control should be handled the same way as with currants and gooseberries (see pages 5 and 7 for details).

To ensure that **currant** and **gooseberry** bushes reach their desired vegetative growth, the bush row area between the beginning of a shoot and the shoot tip must be free of weeds. You can use general orchard hoeing machines for this purpose (see pages 5 and 7 for details).

A row of **high-bush blueberries** should be free of weeds the entire year. The removal of weeds is generally performed manually (e.g. by using a hoe). The blueberry roots should be injured as little as possible during this process. It is particularly important to remove quitch grass (*Agropyron*) and all other runner-producing weeds early on in their developmental stage if possible. Ideally, all runner-producing weeds should also be removed from the orchard path e.g. by using a harrow (see page 9 for details).

- The putting up and taking down of protective covers must be time-efficient.
- High durability against wind and hail.
- Proper aeration must be ensured.

Once treated poles and galvanized iron are exposed to weather, considerable amounts of pollutants (e.g. heavy metals) can enter the soil (also see FiBL guide «Creating a Dwarf-Tree Orchard»).

For ecological reasons, designs not utilizing treated timber and galvanized metal are to be favoured (see illustration).

It is generally possible to construct your own weather protection; however, this takes usually quite some effort and might ultimately not be efficient.

Training systems

Selecting the appropriate training system will have a significant impact on the yield and health of the crop as well as on the picking efficiency.

You should avoid systems with wide and insufficiently aerated foliage walls. In general, it is better to select a system with narrow foliage walls and smaller distances between rows than systems with wide foliage walls and large distances between rows.

See pages 2 to 8 for further information on crop-specific training systems.

Efficient harvesting of currants.

Häberli AG, Neukirch

Healthy fruit from gooseberry and currant bushes can be stored the longest.

Harvest

By harvesting the fruit during the early morning hours, the fruit quality will be maintained for the longest period of time. If possible, only dry fruit should be harvested. You can significantly facilitate the harvest and prevent the bruising of pressure-sensitive fruit by using a picking wagon with a good suspension. The highest picking efficiency will generally be achieved by utilizing a large workforce within a short period of time.

After the harvest, the berries should be taken to a shady, cool location as quickly as possible. Berries intended for further processing are usually frozen at a temperature of -18 °C.

Dessert fruit (i.e. no further processing) is picked directly into 250 g or 500 g (net) berry containers.

Storage

Berries should generally be sold and eaten as soon as possible after the harvest; however, you might be required to store your berries temporarily due to harvest peaks or unfavourable market situations.

Maximum storage period:
(at a relative humidity of 90 % and a temperature of 0–1 °C; also variety dependent)

- 3 days
- 4 days
- 10 days
- 14 days
- 17 days
- 21 days

The storage period can be increased and the decaying process (e.g. grey mould caused by Botrytis cinerea) postponed by artificially increasing the CO_2 content. Whether this measure is economically efficient has to be assessed on a case-by-case basis.

Important:
To ensure that no condensation (quality loss) is forming on the fruit after removing it from storage, the temperature outside the storage facility (at a relative humidity of 70 %) may only be up to 5 °C higher than the actual temperature of the fruit. If it is not possible to gradually adjust the fruit temperature to the temperature outside the storage facility (approx. 5 °C per hour), the storage temperature may only be up to 5 °C lower than the outside temperature.

Phytophthora fragariae var. rubi

Root rot

Andi Schmid

FAW

Top and bottom image: deseased plant on the left, healthy plant on the right

How to recognize the disease?

Young canes:

- Shoot tips wither; leaves brighten and dry up; shoots die off by early summer.

Mature canes:

- Stunted lateral shoots; leaves brighten and dry up; shoots die off by harvest time.

Roots:

- Bark shows dark discoloration, few radicles.

Important facts

- Can endanger the entire crop.
- Compressed soils as well as permanently or alternately wet soils facilitate diseases.
- Highest danger of infection in spring and autumn at ground temperatures of 12–16 °C.
- Spreading of disease through diseased plant material, soil tilling equipment, footwear and ground water.
- Does not infest strawberry plants.

How to prevent the disease?

- No crops on compressed, permanently or alternately wet soils.
- Use only healthy planting stock.
- Add properly decomposed compost on a regular basis; combine with dyke-based crops (see page 3).
- Irrigate sparingly in spring and autumn.
- Do not exchange machinery with infested farms.
- Avoid varieties susceptible to root rot.
- Do not grow raspberries on the infested area for a time period of 15 years.
- Weather protection from early spring to harvest end. Risks: increased numbers of spider mites, snow pressure, rapid material fatigue.

Didymella applanata, Botrytis cinerea, Leptosphaeria coniothyrium, Elsinoe veneta

Raspberry shoot diseases

RAC

Walter Scherer, Dresden (D)

Didymella in summer, *Didymella* and *Botrytis* in winter

How to recognize the disease?

Didymella applanata

- Purple/brown spots on the buds of young canes which rapidly grow in size.
- Silvery-grey discoloration with small black fruiting bodies.
- Stunted budding or no budding at all.

Leptosphaeria coniothyrium

- Extensive purple/brown spots on the base of young canes.
- Diseased canes die off the following year.

Botrytis cinerea (see section on grey mould), *Elsinoe veneta*

- Initially purple spots on canes, petioles and blades; later on whitish/grey indented spots.

Important facts

- Unlike root rot, cane diseases never lead to the death of the entire plant.

How to prevent the disease?

- Provide better crop aeration: remove superfluous young canes and weeds (see pages 2–3), keep the orchard path vegetation to a minimum.
- Avoid cane injuries: e.g. by eliminating raspberry cane midge (see page 23), removing strong canes with torn bark, avoiding areas of friction.
- Remove cleared canes from the orchard immediately after the harvest.
- Apply nitrogen sparingly.
- Put up weather protection from shooting to harvest end (see page 15). Risk: increased numbers of spider mites.

Botrytis cinerea

Grey mould

Walter Scherer, Dresden (D)

How to recognize the disease?

Fruit:

- Covered in grey, dusty fungal coat.
- Later on, the soft and decaying berries shrink and harden.

Canes:

- Light brown spots around the buds of young shoots which rapidly increase in size.
- Silver-grey discoloration in winter with large, black fungal coats.
- Weak budding or no budding at all.

Important facts

- Disease can lead to extensive losses if it rains during the harvest.
- Fruit that appears healthy on the outside can decay within a short storage period – especially, if they were picked while being wet.
- The fungus remains on the canes during winter (see raspberry cane disease).
- Blooming time is the main infection period.

How to prevent the disease?

- Put up weather protection from harvest beginning to harvest end.
- Apply nitrogen sparingly.
- Remove diseased canes in winter.

Tetranychus urticae

Two-spotted spider mite

Ulrich Remund, Wädenswil

Andi Schmid

Left: Predator mite Right: Two-spotted spider mite

How to recognize the disease?

Leaves, shoots:

- Bright square speckles on leaf tops. Leaves will dry up later on.
- Delicate cocoons containing mites in different developmental states.

Mites:

- Usually on the bottom of leaves.
- 0.3–0.6 mm in length, yellowish with two dark spots on each side of their bodies.

Important facts

Infestation Control:

- Inspect at least 50 leaves from the middle section of the plant.

Damage threshold:

- *Prebloom:*
  10 % of leaves from the middle section are infested.
- *After harvest:*
  40–60 % of leaves from the middle section are infested.
- *After the end of August:*
  10–20 % of leaves from the middle section are infested.

Take predator mites into consideration!
Rule of thumb:
If there are more leaves with predator mites (i.e. either predator mites only or both, spider mites and predator mites) than leaves with spider mites only, there is usually no need to combat the infestation directly.

How to recognize the disease?

- Don't use any weather protection or use it only during the harvesting time.
- Leave cut-off mature canes in the stand until their leaves have withered. This way, predator mites are able to move to young canes.

How to combat the infestation directly?

- Fatty acids (soap compounds); refer to product instructions for details on concentration. It is particularly important to spray the bottom surface of leaves in order to control the infestation successfully. Caution: Do not spray into the flowers as this might cause fertilization problems.

Byturus tomentosus

Raspberry beetle

FAW

FAW

How to recognize the disease?

Larvae:

- 6–8 mm in length.
- Yellow/brown.
- Feed on the receptacle and drupelets.

Beetles:

- 3.5–4.5 mm in length.
- Brown to grey-brown; covered in low-lying hair.
- Hollows out flower buds and feeds on flowers and young leaves.

Leaves:

- Slashed leaves.

Important facts

- The main damage is caused by larvae (infested fruit).
- An infestation can make the entire crop unmarketable.

How to prevent the disease?

- Choose varieties that bear fruit in autumn instead of summer (autumn varieties are rarely infested).
- Avoid areas close to forests.

How to combat the infestation directly?

- Put up a white sticky trap («Rebell bianco») in the stand during the shooting stage. Check it at least every second day. As soon as the first beetle has been trapped, put up a simple (uncrossed) «Rebell bianco» sticky trap at 3 to 5 m intervals.

Different species

Aphids

Andi Schmid

Damage caused by currant aphids.

How to recognize the disease?

- Deformed shoots and leaves.
- Purple blisters on red and white currants, yellowish-green blisters on black currants (currant aphid, *Cryptomyzus ribis*).

Important facts

- Aphids not only cause damage by sucking plant juices, but also by transmitting viral diseases.

Transmission of dangerous viral diseases is possible.

If heavily infested, severely stunted leaves and shoot deformations.

Aphids sucking on shoot tips cause a great deal of damage.

Rarely a problem.

How to prevent the disease?

- Apply nitrogen sparingly.
- Create favourable conditions for beneficial insects (e.g. by creating ecological buffer zones next to the cultivation).

How to combat the infestation directly?

- *Insecticides:* Pyrethrin, Rotenon, fatty acids or mixed insecticides.
- *Time of application:* Before the occurrence of shoot or leaf deformations.

Rhabdospora ramealis

Blackberry cane disease

Andi Schmid

Left: healthy young shoot, right: infested cane

How to recognize the disease?

Young canes:

- Dark green, pinhead-sized spots on the base of shoots.
- Initially the spots turn reddish; then they take on a brownish colour and are surrounded by red borders.
- Spots increase in size; they merge partially and spread to canes on the top.

Mature canes:

- Leaves and flowers wither and dry up from the shoot tip to the shoot base.
- Shoots above the infestation areas die off.
- Usually rows of bumps (pycnidia) form in spring; white fungal growth emerges from these bumps during wet weather conditions.
- Spots start to brighten from the centre outwards.

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Infested cane

Important facts

- This disease is often mistaken for frost damage; however, in the case of frost damage, there are no disease symptoms on young canes nor are there any detectable pycnidia in spring.
- Spores are mainly spread from April to June.
- Time period between infection and breakout of disease: 2 to 8 months (!), i.e. symptoms might not be visible on mature canes until spring of the following year.
- There are also other diseases that might cause damage on blackberry canes; however, a laboratory test is usually required for a specific diagnosis.

How to prevent the disease?

- Put up weather protection from the time young shoots start to grow to the harvest end.
- Avoid varieties susceptible to the disease.
- Remove heavily infested canes and burn them (before young shoots develop!).

How to combat the infestation directly?

- Fungicide treatment from the time young shoots start to grow to the beginning of harvest (Caution: adhere to the required waiting period!); it is best to apply the fungicide before rainfall.

MLO (mycoplasma-like organism)

Rubus stunt

Andi Schmid

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How to recognize the disease?

- Formation of many, thin and usually infertile young canes («witch's broom»).
- Deformed flowers with outgrowths, petals are green or reddish, sepals are elongated and thin.

Important facts

- The disease is gaining importance.
- Can lead to extensive yield loss and may endanger the entire crop.
- The disease is transmitted by sap-sucking insects. Cicadas play a major role in the transmission.
- It has not been entirely explained why some varieties are more and others less susceptible to the infestation.
- A few months may pass between the time of infection and disease outbreak.

How to prevent the disease?

- Use only healthy planting stock.
- No planting in or near infested areas.

How to combat the infestation directly?

- Immediately remove and destroy infested plants.
- Applications against disease-transmitting insects are hardly effective.

Acalitus essigi

Blackberry mite

FAW

How to recognize the disease?

- Ripe berries with drupelets that remain red, hardened and sour.

Important facts

- Mites start to be active from March onwards.
- Degree of infestation increases during the course of the harvest.
- The mites are not visible to the naked eye (0.16–0.2 mm in length).

How to prevent the disease?

- Remove old canes from the plant after the harvest (Caution: increases the danger of frost damage).

How to combat the infestation directly?

- By using sulphur:
  1st application (2 % solution) once the lateral shoots of the canes are 0–10 cm in length.
  2nd application (1 % solution) once the lateral shoots of the canes are 10–20 cm in length.

Important: The higher the air temperature, the better the effect of sulphur.

Sphaerotheca mors-uvae

American gooseberry mildew

Walter Scherrer, Dresrden (D)

Georg Vukovits, Wien (A)

How to recognize the disease?

- Shoot tips and young leaves are covered with white fungal mycelium.
- Shoot tips die off.
- Partially new growth of broom-like shoots.
- Fruit are initially covered in white mycelium that turns rough, brown and scabby-looking later on.
- Similar to symptoms of gooseberry plants; however, fruit are hardly infested.

Important facts

- The fungus remains on the shoot tips during winter and infects buds.
- Can be mistaken for the European gooseberry mildew *(Microsphaera grossulariae)*, which hardly causes any damage and usually emerges after the harvest (predominantly on the bottom of leaves).

How to prevent the disease?

- Avoid plant varieties susceptible to the disease.
- Apply nitrogen sparingly.
- Remove and destroy diseased shoot tips.

How to combat the infestation directly?

Before shooting:

- Apply sulphur (0.5 % solution) or fennel oil (0.4 % solution).

After shooting:

- Depending on the degree of infestation, apply fennel oil (0.4 % solution).

Caution: Do not spray onto open flowers since this might cause shatter. Many plant varieties are sensitive to sulphur after shooting.

Botrytis cinerea

Shoot dieback

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How to recognize the disease?

In spring:

- Shoots or individual parts of shoots do not develop or remain in shooting stage.

Before the harvest:

- Leaves turn yellowish and wither.
- Berries ripen immaturely, shrink and frequently fall off.
- Shoots dying off at the base exhibit bark necrosis of up to 20 cm in length. The wood underneath is grey/brown; the pith is brown/black.

Important facts

- Presumably, the infection takes place between October and April through cuts or other wood injuries.
- Black currants and gooseberries are rarely infested.
- Shoot dieback can also be caused by other pathogens e.g. canker disease *(Nectria cinnabarina)*.

How to prevent the disease?

- Remove any fruit-bearing canes that had to be cut to speed up recovery immediately after the harvest (before the main infection period).
- Cover cuts and wood injuries with wound dressing.

Colletotrichum acutatum

Colletotrichum

Jacob Rüegg, Wädenswil

FAW

How to recognize the disease?

- The ripening fruit turn milky and transparent, shrink and usually fall off later on (blight).

Fruit:

- Shrink; formation of orange/red mucislage.

Shoots and leaves:

- Red spots.

Important facts

- This disease has not been fully explained.
- Wet periods of more than 12 hours can increase infections.
- The fungus remains on (matured) timber and fruit mummies during winter.
- The fungus also infests strawberries, elder and cherries (sour rot).

How to prevent the disease?

- Select well-aerated locations.
- Select loosely spaced training systems.
- Thin out plants consistently.
- Remove any cut material from the plants.
- Remove all fruit mummies and stalks during the harvest.
- Avoid varieties susceptible to the disease.
- Put up weather protection from the harvest beginning to harvest end.

Drepanopeziza ribis

Leaf spot

Gerog Vukovits, Wien (A)

How to recognize the disease?

- Brown spots on the top and bottom surface of leaves; spots merge if it is a very heavy infestation.
- Leaves turn yellow and partially fall off in July.

Important facts

- The fungus remains in the fallen off foliage during winter.
- Varieties descending from Ribes petraeum (red flowering) are resistant; however, varieties descending from *R. rubrum* and *R. vulgare* (green flowering) are very susceptible to the disease.
- Gooseberry seedlings are particularly endangered during their breeding.
- Can be mistaken with Septoria leaf spot *(Mycosphaerella ribis)*. In the case of a Septoria infection, only the young leaves that are infected turn yellow rapidly; older leaves turn yellow slowly.

How to prevent the disease?

- Avoid varieties highly susceptible to the disease.
- After the foliage has fallen off, rake it onto the orchard path and mulch it.

Cronartium ribicola

Blister rust

FAW

Walter Scherer, Dresden (D)

How to recognize the disease?

- Increasing numbers of yellow/orange spore accumulations on the bottom of leaves from June onwards.
- The spore accumulations take on a column-like shape, 1.0 to 1.5 mm in length, from July onwards.
- Leaves fall off prematurely.

Weymouth pine:

- Spindle-shaped cankers on branches and trunk.
- White or yellowish fungal tissue breaks through the bark later on.

Important facts

- The fungus switches hosts; it undergoes certain developmental stages on 5-needled pine trees. Weymouth pine trees (*Pinus strobus*) seem to be particularly important hosts in Central Europe.
- The fungus is known to survive even without intermediate hosts.
- Apart from *C. ribicola,* other rust fungi have also been found on these types of pine trees.
- Black currants are particularly susceptible to the disease but also red currants descending from *Ribes petraeum* as well as *Ribes alpinum* and *Ribes grossularia* can be infected.

How to prevent the disease?

- Avoid varieties susceptible to the disease.
- Remove infested pine trees growing close-by.

How to combat the infestation directly?

After shooting:

- Apply fennel oil (0.4 % solution) every 2 to 3 weeks depending on the degree of infestation.

Caution: Do not spray onto open flowers since this might cause shatter.

Virosen

Raspberry mosaic

How to recognize the disease?

- Collective term for a number of different viral infections. Usually on raspberries, rarely found on blackberries.
- Chlorotic, unevenly distributed spots on leaves or chlorotic, discoloured leaf tissue along veins or net-like yellowing along lateral veins.

Important facts

- Transmission via the small raspberry aphid (*Aphis idaei*) and the large raspberry aphid (*Amphorophora idaei*).
- Do not mix them up with the raspberry leaf mite (see page 24).

How to prevent the disease?

- Some berry varieties are resistant to virus-transmitting aphids.

Phragmidium rubi-idaei

Raspberry rust

Max Kopp, Koppigen

How to recognize the disease?

- Initially greenish/yellow pustules on the leaf top; then orange/red spore accumulations on leaf bottoms and stalks which turn black after some time.

Important facts

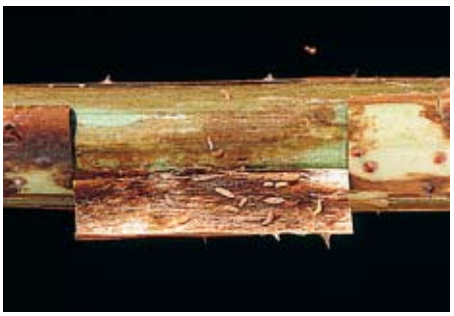
- The fungus remains only on fallen foliage during winter.

How to prevent the disease?

- Put up weather protection from the beginning of vegetative growth to the end.
- Mulch leaves or remove them from the orchard.

Resseliella theobaldi

Raspberry cane midge



FAW

How to recognize the disease?

Shoots:

- Brown indentations on young canes growing close to the soil.
- Reddish larvae, approx. 3.5 mm in length, underneath bark.

Midge:

- Dark brown/red, 1.4–2.1 mm in length, long legs.

Important facts

- Midge only lays eggs if bark is torn or cut.
- Can be mistaken for the raspberry gall midge (see below).

How to combat the infestation directly?

- Remove the first batch of young canes when they are approximately 20 cm in length as well as any thick canes with torn bark.

Lasioptera rubi

Raspberry gall midge

Andi Schmid

How to recognize the disease?

- Thick-walled galls are visible on one side of the cane.
- Occurs rarely.

Important facts

- Do not mix-up with the raspberry cane midge (see above).

How to combat the infestation directly?

- Rarely necessary.

Anthonomus rubi

Strawberry or Raspberry blossom weevil

FAW

How to recognize the disease?

- Snapped off blossoms which dry up and fall off afterwards.

Beetle:

- Black/brown, 2.0–3.5 mm in length.
- Slender antennae.
- Fore wings show a lengthwise series of dots.

Important facts

- The beetle remains under foliage or in the ground during winter.
- A significant number of beetles come from forests.
- The female is able to destroy 20–30 flower buds by laying an egg in each flower and gnawing at the pedicel.
- Also infests strawberries and roses.

How to prevent the disease?

- Avoid areas close to forests.

Phyllocoptes gracilis

Raspberry leaf mite

Walter Scherer, Dresden (D)

How to recognize the disease?

Leaves:

- Yellowish/green brightened spots of different sizes on the top surface of leaves.
- Hairless spots on the leaf bottom.
- Might be mistaken for a viral infection (see page 23); however, viral infections do not cause hairless spots on the leaf bottom.

Fruit:

- Bright, hairless spots.

Stunted fruit growth

How to recognize the disease?

- Small, stunted fruit with few drupelets.

Important facts

- The specific cause of this disease is still being debated. Potential causes are: insufficient pollination (bad weather, not enough insects), insufficient self-fertilization in certain varieties, viral infestation (symptoms do occur without viral infection, however), and selection errors during reproduction.

How to prevent the disease?

- Use only healthy plant material.
- Improve pollination through insects e.g. by encouraging wild bees (see FiBL guide «Creating a Dwarf-Tree Orchard»).
- No large-scale cropping with one plant variety only.

Mice

Andi Schmid

Mole

Andi Schmid

Burrow of common vole

Important facts

- Crop damage from mice feeding on fruit can lead to extensive yield losses.
- The damage threshold is zero.

How to prevent the disease?

- Mice control has to be performed the entire year i.e. also in winter.
- Please refer to the FiBL guide «Creating a Dwarf-Tree Orchard» for mice control strategies.

Frost damage

Max Kopp, Koppigen

Andi Schmid

How to recognize the disease?

- Pith and/or wood as well as bud tissue turns brown.
- Insufficient or no shoot development on entire canes or cane sections.
- Young shoot tips or blossoms darken.

Important facts

- Winter frost is usually more damaging to bush berries than late frost (the opposite applies to pip fruit and stone fruit); frost protection by using irrigation systems is therefore not very effective.
- Thick canes as well as diseased canes are particularly susceptible.
- Wind-exposed areas are particularly at risk.
- Big differences in frost vulnerability among berry varieties.

Often mixed up with cane disease (see page 20).

How to prevent the disease?

- Combat cane and shoot diseases (see pages 18 and 20).
- Select suitable locations (see pages 10 and 11).
- Avoid plant varieties susceptible to the disease.
- Remove the first batch of young canes or thin out young canes to avoid thick canes (see pages 2 and 3).
- Take down canes or wrap them with jute fabric (see pages 4 and 5).

Peronospora sparsa

Downy mildew

Andi Schmid

How to recognize the disease?

- Yellow brightened splotches on the leaf surface which turn red rapidly.
- The blotches are usually square and bordered by veins; spreading occurs along the leaf midrib.
- Leaves will fall off in case of a heavy infestation; the fruit remains red and dries up.

Important facts

- Varieties differ in their susceptibility to the disease.

How to prevent the disease?

- Avoid plant varieties susceptible to the disease.
- Remove weeds consistently in areas of young cane growth.
- Put up weather protection from the beginning of the vegetative growth to the end.

Thielaviopsis basicola

Black root rot

FAW

Left: diseased, right: healthy

How to recognize the disease?

- Entire plants die off in spring.

Important facts

- Soils with high pH levels and moisture content promote the disease.
- Spores can remain in the soil for up to 5 years.
- The fungus has a number of hosts e.g. clover, beans, tobacco, tomatoes or carrots.

How to prevent the disease?

- Avoid very wet soils with high pH levels.
- Do not cultivate any of the fungal hosts as a preparatory or neighbouring culture.
- Wait at least 5 years before replanting infested areas with currants or gooseberries.
- Use only healthy planting stock.

Cecidophyopsis ribis

Blackcurrant gall mite

FAW

How to recognize the disease?

- Diseased buds are swollen into big round balls; they fail to develop and dry up.
- Similar to blackcurrants; however, buds do not swell but remain somewhat loose.

Important facts

- The mites transmit the virus causing stinging nettle-like leaves and increase the occurrence of shatter (see page 26).
- Varieties differ in disease susceptibility.

How to prevent the disease?

- Avoid plant varieties susceptible to the disease.

How to combat the infestation directly?

- Remove and destroy diseased buds or shoots before blooming.

Viral atavism

Stinging nettle-like leaves

Georg Vukovits, Wien (A)

left: healthy, right: diseased

How to recognize the disease?

- Infestation occurs mainly on black currants; sometimes also on red currants.
- Formation of small, narrow non-lobed or partially lobed leaves.
- Highly elongated inflorescences.

Important facts

- Transmission through blackcurrant gall mite (see information on the right).

How to prevent the disease?

- Avoid plant varieties susceptible to the disease.

How to combat the infestation directly?

- Cut down infested shrubs.

Phragmidium violaceum

Blackberry rust

Andi Schmid

How to recognize the disease?

- Initially dark red blotches on the top surface of leaves; then orange/red spore accumulations that gradually turn brown and black.

How to combat the infestation directly?

- Hardly necessary.

Dasyneura tetensi

Blackcurrant leaf midge

How to recognize the disease?

- Diseased leaves become wrinkly and twisted; usually they gradually turn black.

Important facts

- Disease occurs rarely.

How to combat the infestation directly?

- Rarely necessary.

Shatter

Andi Schmid

Top: no shatter Bottom: shatter

How to recognize the disease?

- Within four weeks after fruiting, single fruit fall off. Strigs are consequently lacking berries and do not meet quality requirements.

Important facts

- Potential causes: characteristics of specific plant variety, insufficient fertilization (e.g. due to adverse climate conditions such as abnormally high or low temperatures during blooming), insufficient amount of pollinating insects in cultivation, aged canes, excessive nitrogen supply during blooming or stinging nettle-like leaf disease (see page 25).

How to prevent the disease?

- Allow canes to continuously regenerate (see pages 6 and 7).
- Apply fertilizer at the right time i.e. main supply of nitrogen not before May.
- Improve pollination through insects e.g. by encouraging wild bees (see FiBL guide «Creating a Dwarf-Tree Orchard»).
- Avoid plant varieties susceptible to the disease.

Synanthedon tipuliformis

Currant clearwing moth

FAW

How to recognize the disease?

Larvae:

- 23–30 mm in length; yellowish/white with brown head.
- Bores into shoots between June and July and causes black burrows in the pith.

Moth:

- Wingspan 20–30 mm, blue/black body, hind body with 4 (male) or 3 (female) light yellow stripes.

Leaves and shoots:

- Leaves wither; shoots develop insufficiently or die off.

How to prevent the disease?

- Thin out plants regularly; do not perform summer pruning before the moth flight in August.

How to combat the infestation directly?

- Remove and destroy diseased shoots.
- Put up traps to reduce the infestation (e.g. wine bottles or commercially available bark beetle traps). Liquid bait: 90 % unfermented fruit juice, 5 % blackcurrant syrup, 5 % vinegar; put up traps at 20 m intervals; replace liquid bait if it is dirty.
- Another combat measure, the so-called «confusion» system, is currently being tested.

different genera and species

Scale insects

FAW

How to recognize the disease?

- Flattened insects with shell-like covering; they attach themselves firmly to host plant.
- Scale insects are broken down into two categories: Armoured (Hard) scales (female scales not permanently attached to scale) and Soft scales (female scales permanently attached to scale).

Armoured (Hard) scales:

San José scale *(Quadraspidiotus perniciosus):*

- Infestation must be reported; quarantinable plant pest!
- The plant tissue surrounding the scales turns red.

Oystershell scale *(Q. ostreaeformis)*
Mussel scale *(Lepidosaphes ulmi)*

Soft scales:

European Fruit Lecanium *(Parthenole canium corni)*
Woolly currant scale *(Pulvinaria ribesiae)*

How to combat the infestation directly?

- Combating of disease is possible; applications depend on plant species.

different genera and species

Sawflies

FAW

How to recognize the disease?

- Larvae: 10–20 mm in length
- Holes within leaf tissue or at leaf margin; sometimes even entire defoliation of host plant.

Important facts

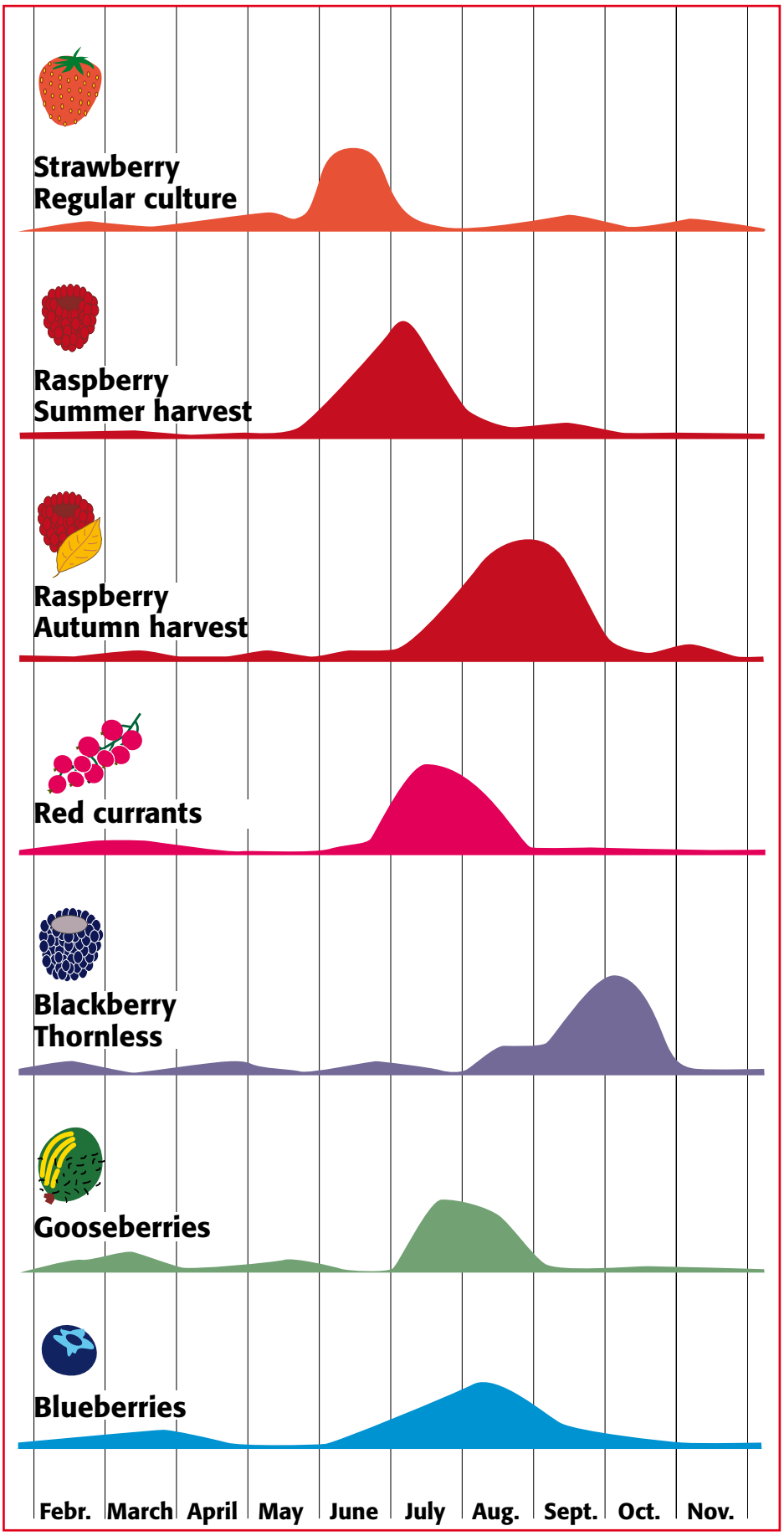
- Infestation occurs quite rarely; however, once plants are infested, the damage can be severe.

How to combat the infestation directly?

- Direct combat is possible; however, further research is currently under way for pesticide approval.

Labour Requirement

Required labour during the course of the year – In comparison to strawberry cultivation



The amount of labour required during the course of the year differs for individual varieties of berries. Depending on the cultivation method, location and selection of berry varieties, the amount of labour required can also differ within a certain berry category. The chart illustrates the required labour as average values for a wide range of berry varieties.

Andi Schmid

Cultivation with a wide selection of berries: Work hardly ever stops.

Economical feasibility

The economical efficiency of a crop depends on different factors such as the selling price, the amount of labour invested and the type of auxiliary supplies used. It is therefore not possible to provide universally valid information on economical efficiency.

Marketing options

You should be clear about potential sales and marketing options before planting a new crop. Suitable distribution channels will depend on the operational structure, the available labour time as well as the geographical location of the orchard. Organic berry crop have to be in compliance with the quality regulations of the respective organic farming certification bodies.

Wholesale distribution

Conditions

- Steady delivery of large quantities must be possible.
- Able to meet high quality standards.
- Suitable transport options must be available (a cooling van might be necessary).
- High flexibility (e.g. must be able to accommodate short-notice orders).

Advantages

- Large sales quantities per delivery.
- Less time spent on marketing.

Disadvantages

- No direct contact with consumers.
- Exposed to more extensive price fluctuations.

Direct sale and distribution

Conditions

- Farm must be suitably located for sales.
- Sufficient sales staff must be available.
- Wide (berry) selection offered.

Advantages

- High prices.
- Fewer price fluctuations.
- Direct contact with consumers.

Disadvantages

- A lot of time is spent on marketing.
- Sales infrastructure is necessary.
- Clientele has to be built-up and maintained.

Self-picking

Conditions

- Farm must be suitably located for sales.
- Sufficient customer service staff must be available.
- Suitable parking lots must be available.

Advantages

- No picking staff required.
- Direct contact with consumers

Disadvantages

- Bad or insufficient picking (20–30 % of fruit – including rotting fruit – might remain on plants e.g. if fewer customers show up during bad weather conditions); introducing a «bonus system» might help: The more rotten fruit a person picks in addition to edible fruit, the less expensive the edible fruit will be.
- The frequent walking of pickers puts a heavy strain on the soil.
- Extensive organization and advertising effort.

Further mechanical processing

Conditions

- Freezing options must be available.

Advantages

- Large quantities (also class II) can be sold quickly.
- Sales are guaranteed (and binding!) after signing the contract.
- Also suitable for remote locations.

Disadvantage

- Lower prices compared to selling dessert fruit.

Abbreviations used

FAW: Federal Research Institute for Fruit Cultivation, Viticulture and Horticulture, Wädenswil, CH

RAC: Station fédérale de recherche en production végétale de Changins, Nyon, CH

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