Greenresilient Factsheet

Transfer mulch in organic greenhouses

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In organic greenhouses, crop rotations are generally intense and lack diversity, green fallows are rare, and production relies heavily on external inputs. Consequently, problems like soil salinity, nutrient imbalances and crop damage from pest and disease are common. In the Greenresilient project the use of transfer mulch is applied as an 'innovative' method and is tested and analysed to determine whether the practice is beneficial for soil health and biodiversity. This leaflet explains the benefits, risks and challenges of transfer mulch, and provides recommendations for practical application.

Benefits of transfer mulch

The application of an organic mulch layer is an effective alternative to plastic mulches for weed management in organic greenhouse vegetable production. Transfer mulch can at least partially replace the positive effects of green fallows in greenhouse crop rotations and provide many other benefits, such as:

- Maintaining humus levels and soil structure,
- Enhancing the biodiversity of soil organisms,
- Boosting the biological activity of greenhouse soil,
- Reducing thermal radiation and evaporation, providing homogeneous soil humidity,
- Lowering irrigation needs,
- Preventing salinisation problems,
- Buffering temperature extremes, and
- Contributing to plant nutrition in the short and long term.

Photo 1 and 2: Nitrogen deficiency symptoms on young tomato plants due to reduced soil temperature under the mulch layer and subsequent delayed nutrient mineralisation.
Source: Patricia Schwitter, FiBL.

Photo 3: Leaf burning due to gas emissions on young tomato plants. Source: Patricia Schwitter, FiBL.

Risks and challenges of transfer mulch

While the benefits of mulching are plenty, there are also some risks and challenges involved in applying mulch in greenhouses, such as:

- Perennial weeds and weed seed import,
- Possible risk of mice and/or snail infestation,
- Nitrogen blockage (subsequent fertilisation is difficult),
- Delayed mineralisation due to reduced soil temperature (see photo 1 and 2)
- Leaf burning due to gas emissions (see photo 3)
- Hand weeding or re-mulching may be necessary, if decomposition is too fast,
- Workload for mulching approximately 5-10 times higher than with plastic mulch.

Practical application

Mulch material choice

When choosing the appropriate mulch material, there are several factors to be considered:

- **Carbon to nitrogen ratio (C:N)**, influenced by the crop and crop stage:
  - <15: tends to decompose quickly and become compacted (young and legume-rich material)
  - 15-25: ideal (e.g. grass-clover at silage harvest stage)
  - >25: risk of slow decomposition and nitrogen immobilization (old cereals, lignified material)
- **Structure**: influenced by cutting length and crop stage (e.g. material that is too young and short leads to compaction and anaerobic conditions; crop mixtures are often ideal)
- **Nutrient content**: mulch nutrient contents should be taken into account in the fertilisation calculation.
  - Nitrogen: 20-40% becomes available to the plant in the short term.
  - Phosphorus and potassium: inputs from the addition of mulch material can be substantial in the short and long term.

Mulch production

Mulch production takes place in the open field, ideally on the same farm to avoid nutrient import. For green manures serving as mulch material, it is crucial to adjust sowing dates to align with the envisaged time of mulch transfer. Weed management measures are recommended after sowing (e.g. harrowing) and possibly at early flowering stage of weeds (with high cutting height) to keep mulch material free of weed seeds. The mulch material should be cut at the correct crop growth stage to allow for high biomass production and a favourable C:N ratio. Harvesting around the flowering stage is ideal

Table 1: Overview of different mulch materials and their characteristics

Fresh mulch material type	Required amount (kg/m²)	Optimal harvest time	Nutrient content and availability	Advantages	Disadvantages
Grass-clover (70:30)	7–9	Early flowering of clover, booting of grasses	• High nutrient import due to high amount of mulch material • Relatively high N-availability	• Readily available in most regions	• Highest amount of mulch material needed • Tends to compact when cut too early • Relatively fast decomposition
Pulses, e.g. broad bean	3–4	Flowering	• High N-availa-bility • Lower P-contents	• Smallest amount of mulch material needed	• Relatively fast decomposition
Cereals, e.g. winter rye	4–6	Booting – early heading stage	• Highest P-content • Low N-availability	• Slow decompo-sition • Early harvest in spring possible	• Relatively high P-values • Possible N-blocka-ge if cut too late
Cereal-Legumes (70:30), e.g. vetch-rye	3–5	Early flowering	• Low nutrient import • Relatively high N-availability	• Good structure • Balanced C:N ration • Small amount of mulch material needed	• Rather late harvest
Silage (diffe-rent mixtures possible)	Depending on crop	Early flowering	• Depending on raw material	• Flexibility with application time • Reduced weed import	• Increased gas emissions after application (risk for leaf burning)

for most green manures and further reduces the risk of importing weed seed to greenhouse soils.

Optimal cutting length is approximately 10 cm, as shorter mulch material tends to compact and longer increases the effort needed for mulch application. A pick-up loader, equipped with the maximum number of blades, usually allows this cutting length. For simpler handling of the mulch material, wilting the green manure is recommended.

Required amount of herbage mulch

The amount of mulch applied varies depending on: crop duration, type and cutting length of the mulch material, irrigation system, etc. As a general principle, an initial mulch layer of 10-15 cm thickness is required to ensure weed suppression until the end of the season. For fresh mulch material, in general, about a threefold area of green manure is needed relative to the greenhouse area covered with mulch.

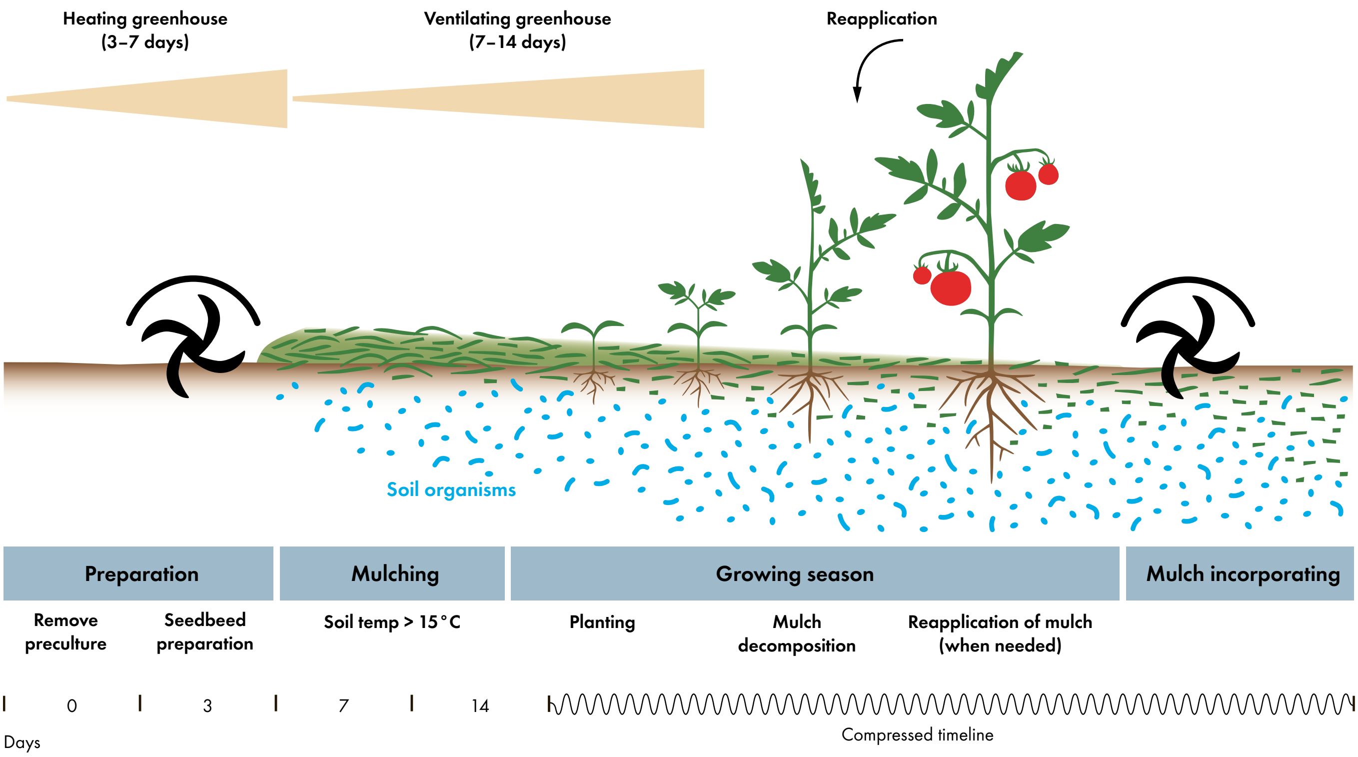
Mulch application

Soil should be allowed to warm up enough before applying mulch in greenhouses, ideally to 15°C or higher. This can be promoted with closing greenhouse ventilation 1-2 weeks before mulching (if compatible with previous crop). Generally, applying mulch prior to planting helps to ensure an even mulch layer. However, if the soil temperature is still too low mulch can also be applied after planting. Fresh mulch material, particularly silage mulch, can cause leaf burning of crops due to gas emissions. Therefore, planting should ideally be delayed for 1-2 weeks after mulching and the greenhouse should be well ventilated during this phase.

If mulch is applied after planting, the material can be pre-ventilated outside the greenhouse for a few days and the greenhouse should remain fully open for the week following mulching (in all weather conditions). Usually, a single mulch application is enough to ensure weed suppression. If the mulch layer decomposes too quickly or the weed suppression is insufficient, a second mulch application during the crop period is possible. Drip irrigation should be installed on top of the mulch layer. Sprinkler irrigation provides a more homogeneous soil moisture content and mulch decomposition.

At the end of the summer crop, if the mulch layer has decomposed sufficiently, completely incorporate it into the soil. If too much mulch material remains for a mechanical incorporation, dispose of some of the material in your compost. Figure 1 schematically represents this mulching technique in greenhouses (see next page).

Figure 1. Schematic presentation of the mulching technique in greenhouses. Source: Samuel Hauenstein



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Cover picture: Tomato crop in a grass-clover mulch layer.
Patricia Schwitter, FiBL

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