(RE)USING HORTICULTURAL PEAT IN ESTONIA.

A STUDY ON CURRENT PRACTICES, POTENTIAL FOR CIRCULARITY AND GHG FLUXES

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THE DECOMPOSITION OF HYDROLYTIC PEAT PRODUCTS INCLUDING AMMONIATED PEAT

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INTRODUCTION

Numerous studies have been made on the decomposition of various materials by soil microorganisms. Considerable information is available concerning the decomposition of fresh plant material added to the soil as green manure, and it has been found that such material undergoes rapid decomposition. This is presumably because it contains relatively large proportions of readily decomposable substances consisting chiefly of simple and complex carbohydrates, amino acids, certain proteins, etc. Such decompositions are apparently accompanied by an increase of the proportions of ligninlike materials in the residues.

How carbon is pooled in soil, what happens with carbon in soil, peat or substrate over the time and management?

All new is a well forgotten old or…

… problems tend just to persist over the time.

LULUCF or time for LULUCF^{+} ?

On-site GHG emissions

Knowledge level: satisfactory

<u>Improvement possibilities:</u>

Better accounting for actual peat properties, land use (ditches, roads, buffering zone), accounting for actual harvesting process, country-based factors considering weather etc.

Off-site GHG emissions

Fuel = 100% C loss

Substrate = ? % loss

Animal husbandry = ? % loss

Knowledge level: low

<u>Improvement possibilities:</u>

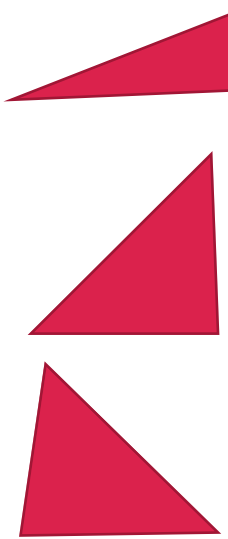
More accurate accounting for substrate use

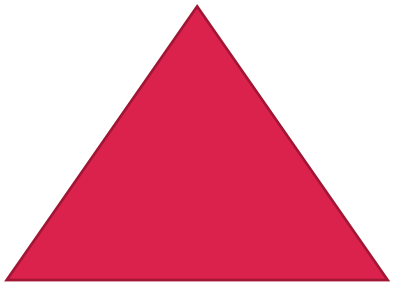
Timeframe

Reuse, recycling, circular economy effects

How to quantify off-site emissions?

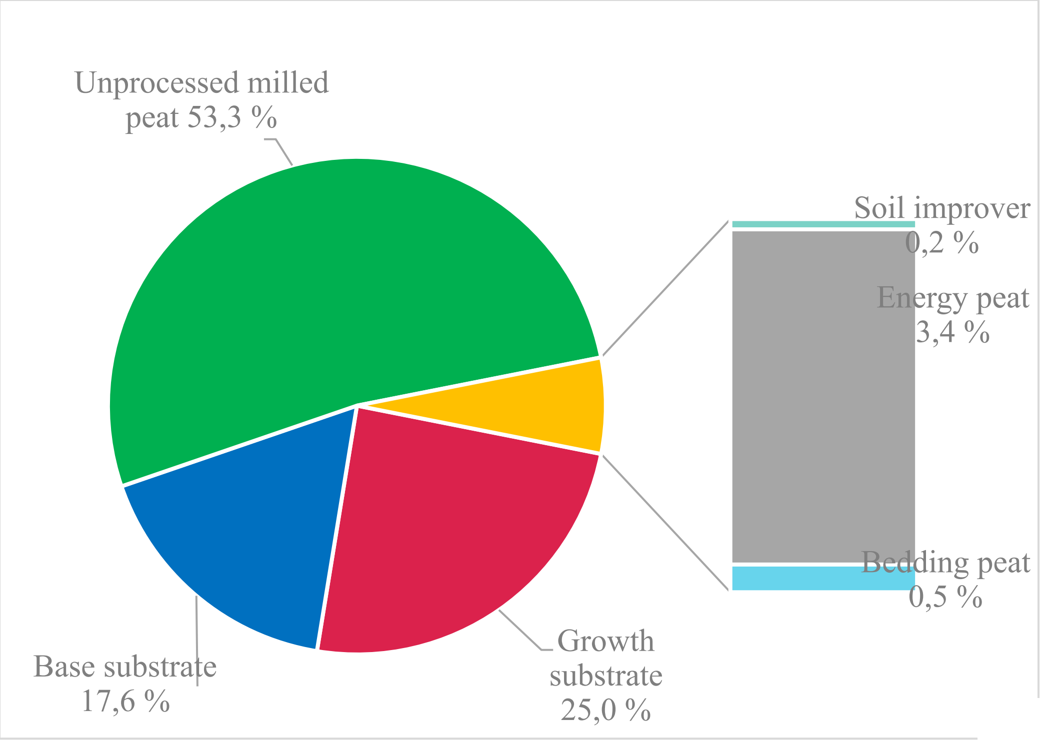
- What is the actual use of produced peat?
- What is the emission factor of substrate?
- What happens with carbon, where and when?





What happens if 1 g of used peat-C will produce CO_2 emissions but final C output is > 1 g? Who is responsible for emissions, who gets credit for C capture?

SALE OF PEAT EXTRACTED IN ESTONIA 2022



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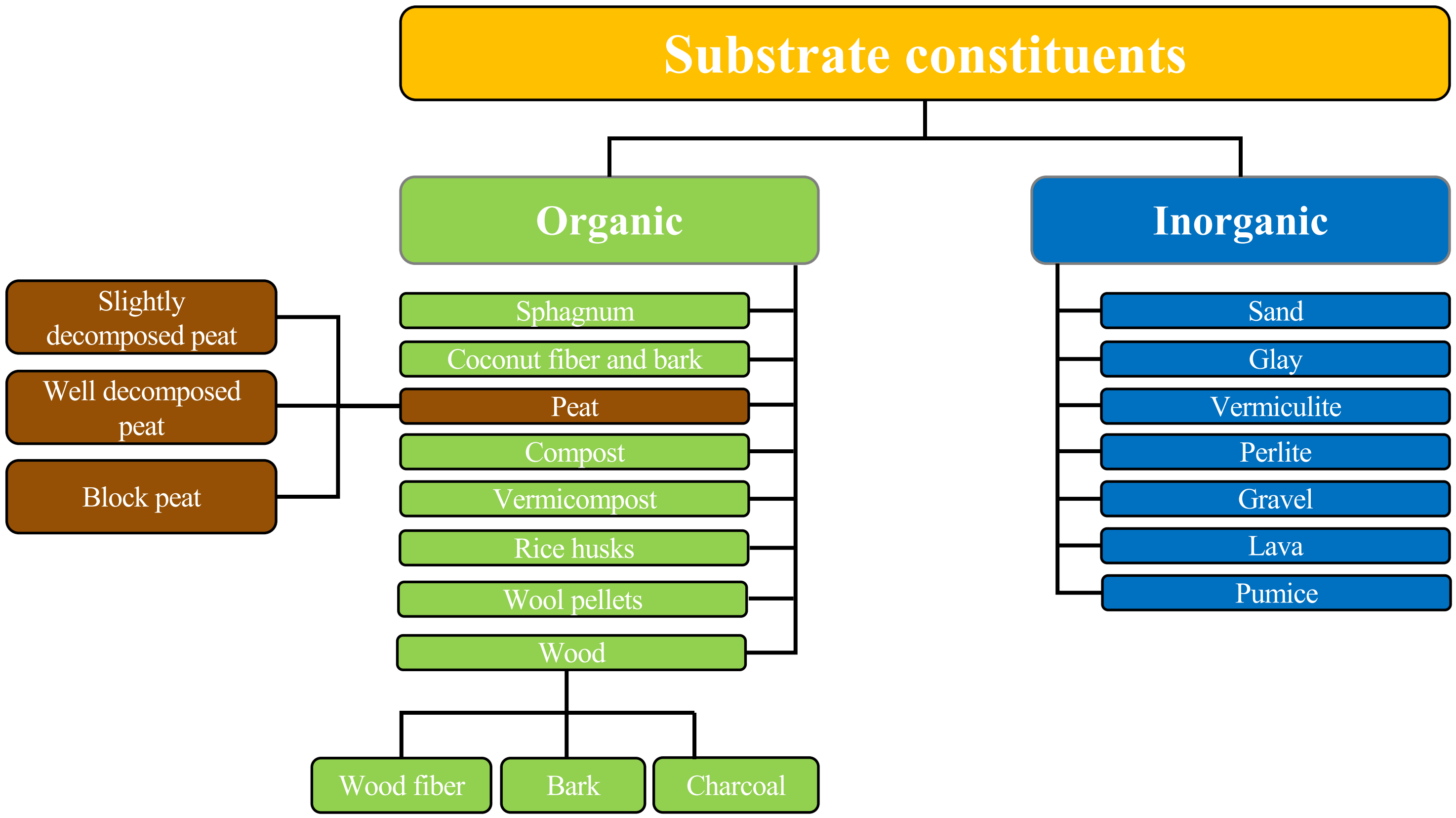

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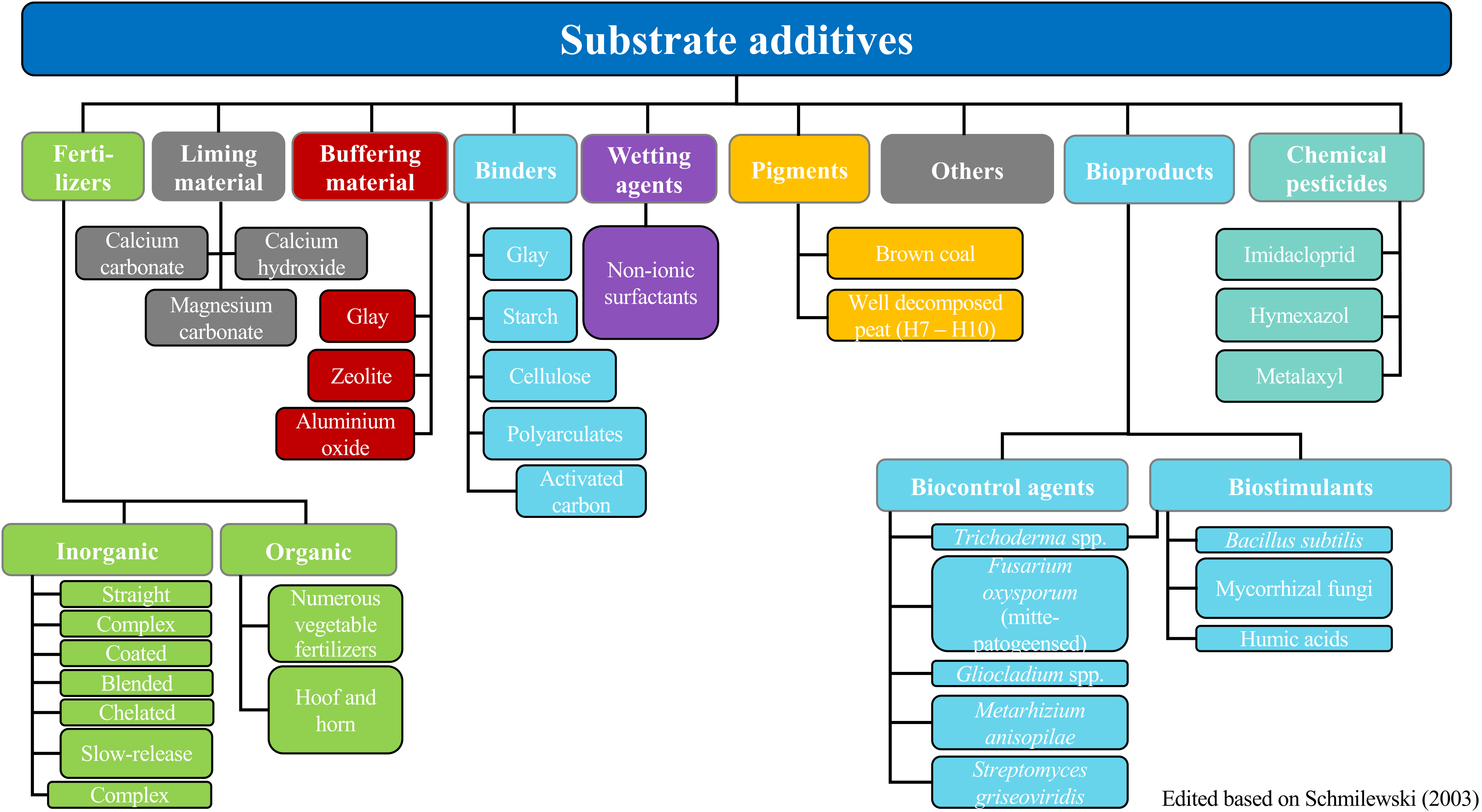

Edited based on Schmilewski (2003)

Ingredients of substrates

Organic ingredients	m^3	Inorganic ingredients	m^3
Slightly decomposed peat	1491	Perlite	10,3
Well decomposed peat	126	Expanded clay	1,0
Block peat	24	Sand and loam	5,8
Coconut fiber	5	Ground limestone	2,5
Wood bark	1	Chalk	0,2
Wood fiber	10	Multimix NPK	0,1
Compost	2,2	Vermiculite	0,01
Charcoal	0,4	Pumice	1,2

ON 1 M^3 OF PEAT CAN BE GROWN:

6670
forest tree seedlings

14 300
herb and salad plants

1 100
perennial flowers

13 000
young vegetable plants

145
fruit trees

560
exotic house plants

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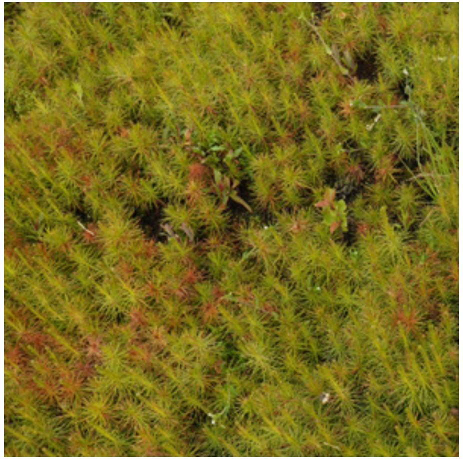
1.

FOREST TREES



- Species:
  - Scots pine
  - Norway spruce
  - Silver birch etc
  - 38,5M in total
- Additives
  - NPK fertilizer (1 kg/m^3)
  - Wetting agent (eg Fiba-Zorb)
  - Slow-release fertilizers (eg Osmocote)
  - Vermiculite, sand or sawdust for cover

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2. VEGE-TABLES

- Species:
  - Cucumber
  - Cabbage
  - Other young plants
- Additives
  - NPK fertilizer
  - Chalk
  - pH 5,6 - 6,5
- Potting
  - ~70 cm^3 pots
  - 1-1,5 months
  - After potting planted to field

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3.

PERENNIAL FLOWERS

- Species
  - Bleeding-hearts
  - Dahlias
  - Many others

- Additives
  - Slow-release fertilizers
  - Perlite or glay
  - pH 5,5 - 6,0

- Potting
  - ~1 litre pots
  - 2 – 6 months

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1.

ORNAMENTAL AND FRUIT TREES

- Species:
  - Apples, pears
  - Chrerries, currants
  - Cypresses
- Additives
  - NPK fertilizer
  - Slow-release fertilizers
  - Stabilizers
  - Limestone powder
- Potting
  - ~7 litre pots/ greenhouse soil
  - 4 – 5 years
  - pH 3,5 – 6,0

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2.

HERBS AND SALAD

- Species:
  - Basil, chives, spinach
  - Lettuce and other salads
- Additives
  - NPK fertilizer
  - Biological products (eg GlioMix)
- Potting
  - ~70 cm^3 pots
  - 1,5 - 2 months
  - After potting planted to field

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3.

OTHERS

- Exotic house plants
  - No industrial production in Estonia
  - Peat used in substrates with other constituents

- Botanical gardens
  - Bot.gardens in Tallinn and Tartu use annually 113 m^3 together

- Mushrooms
  - No industrial production in Estonia on peat substrates, only on wood-based substrates

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AFTER-USE & CIRCULARITY

Circular economy is an economy and a way of thinking that aims to maintain the value of products and materials as long as possible. Waste are being generated and resources used as little as possible, and when the product reaches to the end of its life cycle, it is used to create a new value.

After-use & circularity

R0	Keeldumine	Refuse	Avoiding substrates; peat-free substrates; hydro-/aeroponica
R1	Ümberkujundamine	Rethink	
R2	Vähendamine	Reduce	Smaller amounts of substrates and peat within them; growing less plants
R3	Korduskasutus	Reuse	Repeated use of same substrate (first in greenhouse, then on field)
R4	Parandamine	Repair	
R5	Renoveerimine	Refurbish	
R6	Taastootmine	Remanufacture	Substrate factory collects and adds the used substrate to the new ones
R7	Kasutusotstarbe muutmine	Repurpose	Used substrates are used as a raw material for new ones: isolation materials, active carbon etc
R8	Ringlussevõtt	Recycling	Toilet peat
R9	Energiakasutus	Recover energy	Energy use of used substrates

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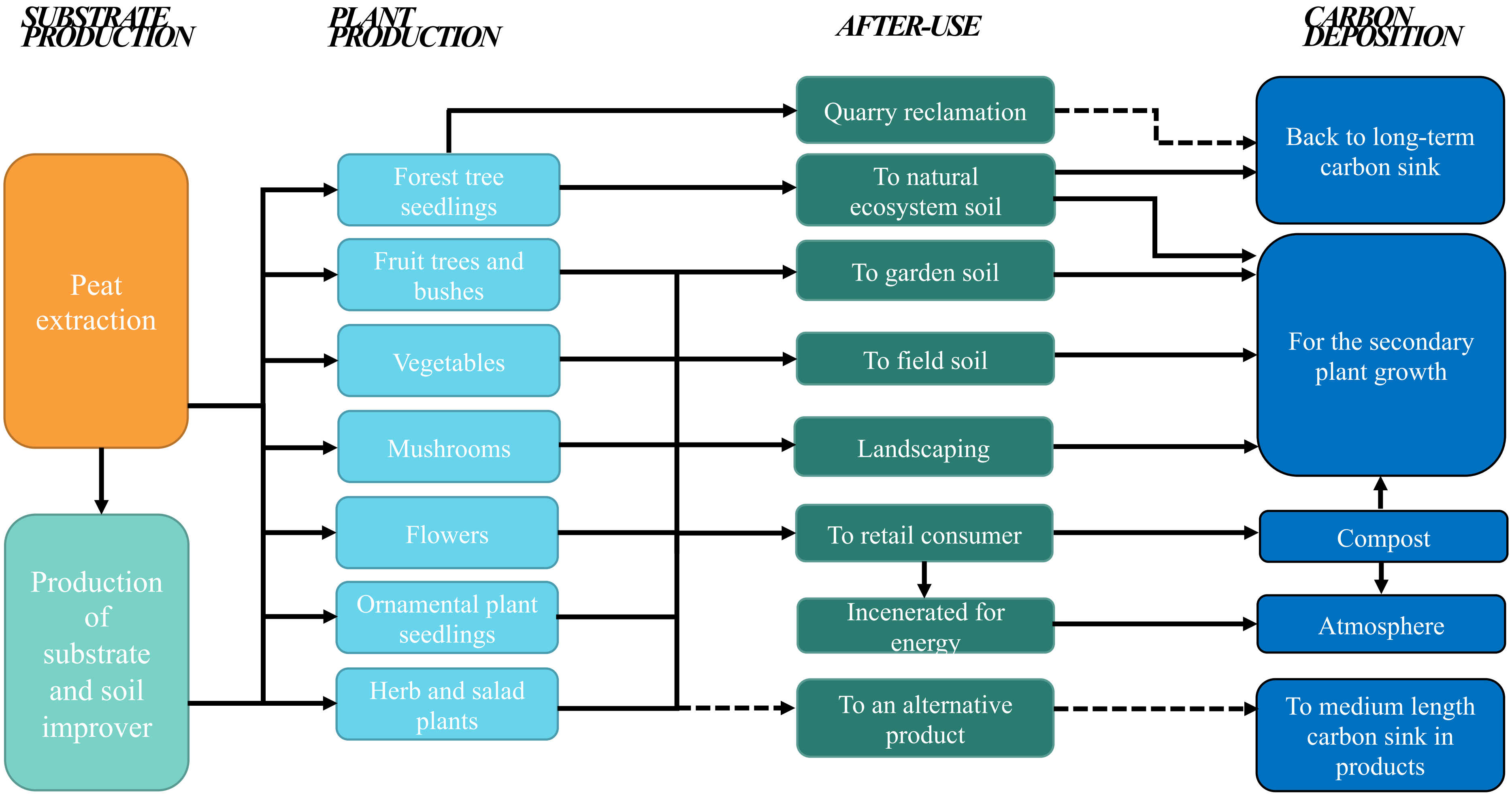
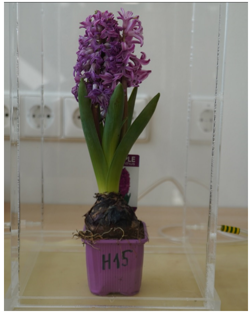

SUBSTRATE PRODUCTION
PLANT PRODUCTION
AFTER-USE
CARBON DEPOSITION
Peat extraction
Production of substrate and soil improver
Forest tree seedlings
Fruit trees and bushes
Vegetables
Mushrooms
Flowers
Ornamental plant seedlings
Herb and salad plants
Quarry reclamation
To natural ecosystem soil
To garden soil
To field soil
Landscaping
To retail consumer
Incenerated for energy
To an alternative product
Back to long-term carbon sink
For the secondary plant growth
Compost
Atmosphere
To medium length carbon sink in products

CARBON BALANCE PEAT SUBSTRATE

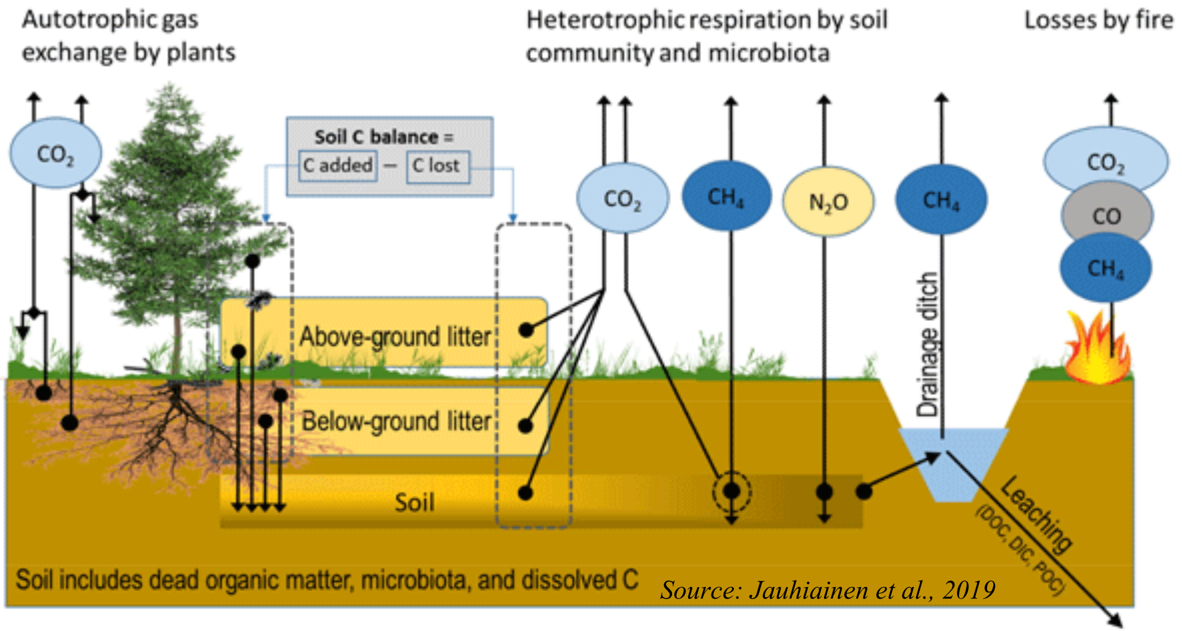


Horticulture

<u>3 substrates:</u>
C-content 42.0% (±1.41);
47.8% (±0.50);
48.4% (±0.55)

Agriculture

Forestry



Source: Jauhiainen et al., 2019

Full balance of C:

Input = substrate + seeds

Growth period = C emission + C capture

Harvest = below-ground biomass + above ground biomass

Lettuce C balance:

Input 3.2 (±0.29) g C → growth, emissions →

2.16 g C above ground
1.11 g C below ground
<u>2.12 g C soil (+DOC)</u>
Sum = 5.39 g C

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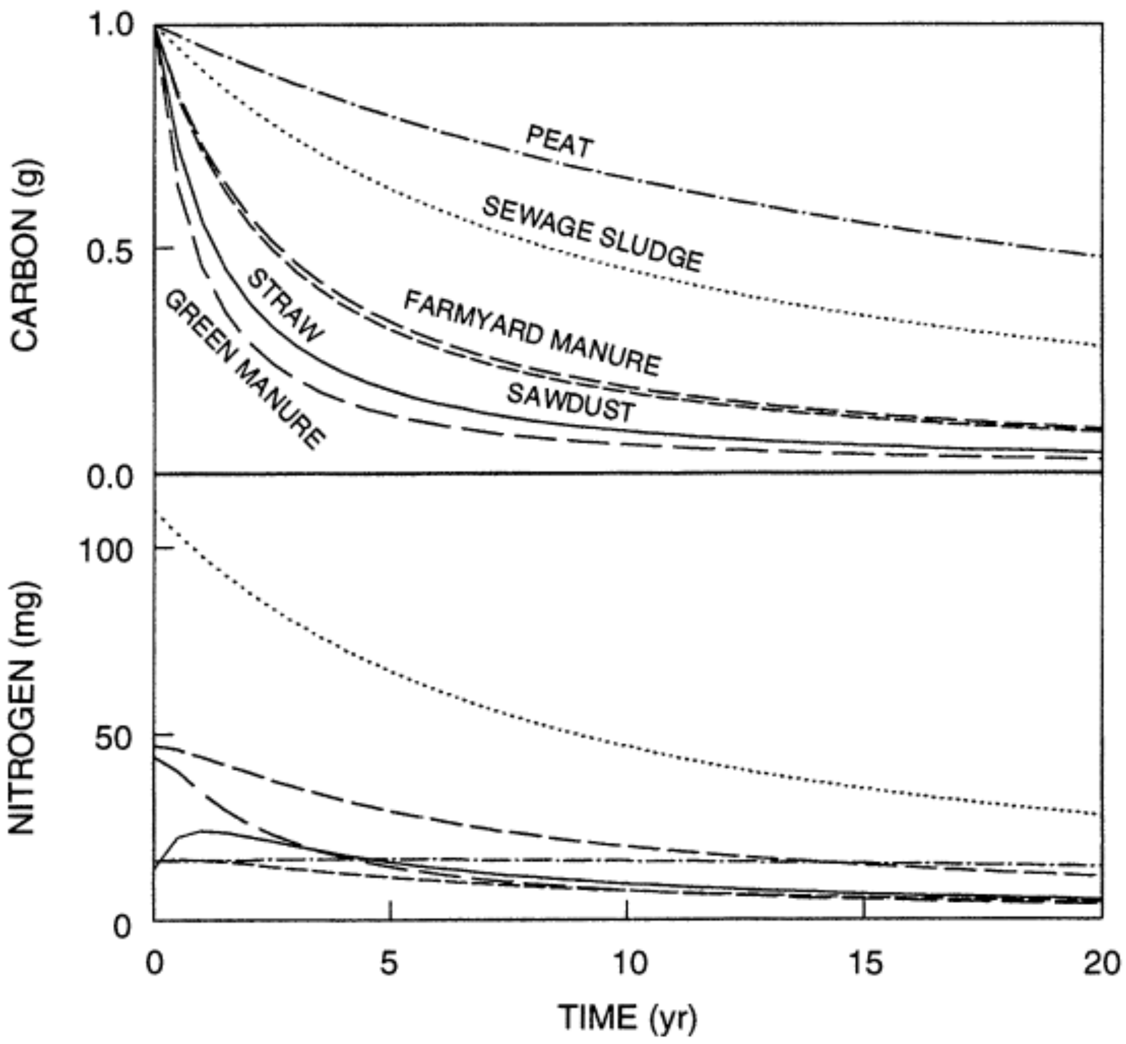
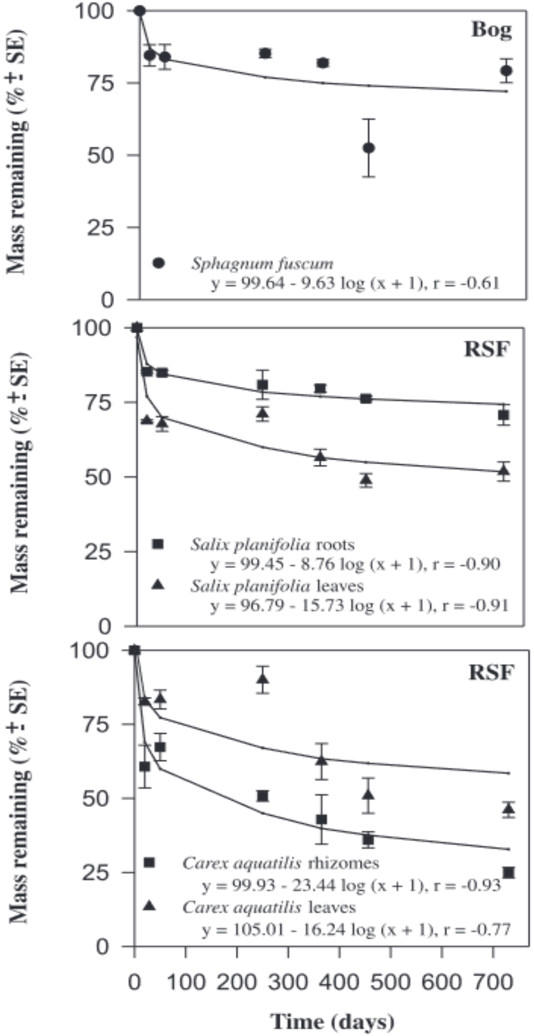


All carbon is not equal!

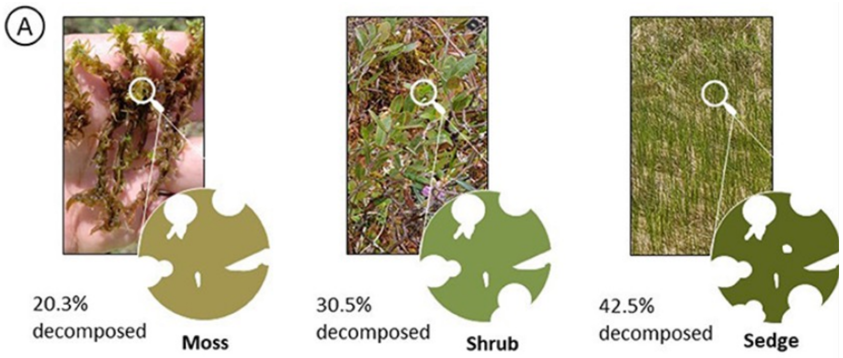
Top: predicted remaining carbon mass following a single addition of organic matter in the long-term field experiment.
Bottom: predicted amount of N in a single addition of organic matter in the long-term field experiment.
Hyvonen et al., 1996

Our forest plant nursery experiment

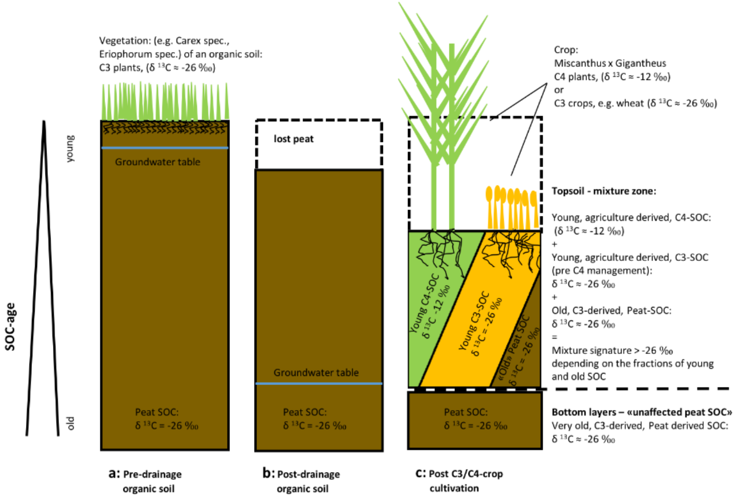
Input substrate C-content: 48.0% (±0.68)
After 1 year C-content: 46.0% (±1.43)



Mass losses (% ± SE) of the dominant indigenous plant species over 20 and 50 days and 8, 12, 20, and 24 months in two peatlands in southern boreal Alberta. RSF, riverine sedge fen. Thormann et al., 2001



Barreto and Lindo, 2020



Bader, 2017

INSTEAD OF CONCLUSIONS

- 1 gramm of peat substrate may enable much bigger C uptake
- The key is afterward use and C losses
- Circular economy is possible – used substrate may be used in peat extraction site resoration but feasibility is questionable
- Re-use is actually ongoing – used substrate is commonly re-used as soil improver. C is stored in topsoil as humus, it improves water retention capacity, increases yield
- Peat substrate for forestry plant nursery – if plants will be planted in drained peatlands, what is the C balance?

etl. EESTI TURBALIIT

This study is in its 1st year, it is supported by Estonian Peat Association and Estonian Environmental Investment Centre

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