Ingredients for soil fertility in vegetable production

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1. Organic matter management
2. Green manure strategy
3. Controlled traffic farming in vegetable production

Change in soil carbon content

Based on results from Kvadratnettet 1986 - 2009

Law of the minimum

Soil organic matter

Significance for physical properties
- Building soil structure and glue for aggregates
- Stores and discharges water – increases ability for soil water retention
- Influence on aeration and temperature

Significance for chemical properties
- Retaining an supplying nutrients
- Cation exchange-capacity
- Acts as pH buffer
- Availability og micronutrients
- Filtration

Significance for biological properties
- Energy for micro-organisms and larger OM consuming organisms
- Mineralization of organically fixed N, P, S
- Root development
- Stimulates microbiological activity and increases soil resilience
Soil organic matter properties on soil type

- Heavy soils
  - Improve water and air management
  - Increase tillage opportunities
- Loamy soils
  - Improve water and air management
  - Less vulnerable for (surface) erosion
- Sandy soils
  - Reduce Drought sensitiveness
  - Increases plant available water
  - Higher nutrient retention
  - Higher resistance to wind

Effective Organic Matter (EOM)

Is the organic matter from manure, compost, crop residues and green manures, which remains one year after application

- Crop residues and catch crops 10-30%
- Slurry and manure 30-70%
- Compost 60-90%

Organic Matter Balance

2-3% OM breaks down yearly

Danish top 25 cm soil contains 110 tons OM/ha
(kvadratnetsundersøgelser)

Which means 2,2 – 3,3 tons OM/ha disappears every year

To maintain OM-level it will need 2.2 tons EOM/år in crop residues, organic amendments, cover crops

...which can be outlined on a crop rotation level or pr.year

Efektiv Organisk Stof (EOM)

Example EOM crop, kg/ha EOM organic fertilizer kg/ha Total
Summer barley/undersown clovergrass, straw left in the field 1310+850+630 280 3070
Potato 875 420 1295
Carrot 700 420 1120
Pea/oil radish 170+850 0 1020
Oats/undersown red clover/straw left in the field 1570+850+900 210 3530
Average EOM pr.year 2007

Afgrøderst er | kg EOS/ha | Efterafgrøder/gødning | kg EOS/ha
---|---|---|---
Broccoli | 640 | Oil radish | 875
Leg | 300 | Red clover, undersown | 1165
Gulerod | 100 - 700 | Grass, 1 year | 1200
Kartoffel, konsum | 875 | Grass, 3 year |
Pøerre | 100 - 450 | Lucerne, 2, år | 2050
Græskar | 250 | Sow slurry (pr.tons) | 9
Hovedsalat | 160 | Cattle slurry (pr.tons) | 50
Havre | 1570 | Deep litter (pr.tons) | 109
Havrehalm | 900 | Champost (pr.tons) | 106
  |  | Compost (pr.tons) | 182
Maintaining OM in top soil

<table>
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<th>O.M. decomposition</th>
<th>Soil Organic Matter</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
<th>4%</th>
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</table>

Comparison of effective organic matter input

**STANDARD**
- Conventional
- Mineral concentrate & mineral fertilizer
- Pig & cow slurry & mineral fertilizer
- Farm yard manure & cow slurry

**HIGH**
- 3000 kg EOM/ha/jr

**LOW**
- 1000 kg EOM/ha/jr

Crop rotation Vredepeel

Sandy soil, 3.5 - 4% OM

Nutriënten Waterproof 2005/8-11 zand PPO-WUR

Organic matter content of the soil

- No trend on the short term
- Net input small compared to soil stock
- Relatively large error of measurement

Nutriënten Waterproof 2005/8-11 zand PPO-WUR

Trends in crop yield 2001-2013

Index crop yields averaged over all years

- Standard
- Low
- High +20%

EOM input crop residues

- EOM input differs per crop
  - Aim ½ of total EOM-input

Potato, Pea, Leek, Sugar beet, Maize, Average
Increasing input of Effective Organic Matter gives
• Increasing Yields
• Decreasing nitrogen leaching fraction on the long term
• Better and more stable soil quality

Animal manure
• Deep litter > cattle slurry > pig slurry > sow slurry
Choice of crop and crop rotation
• Cereals are low-cash-crop, but positive in EOM-supply
• Leave straw
• Ley or alfalfa
Green manure
• Dependant on species
• Be aware of nematodes
Compost
• Stable organic material

Composted household waste?
• Garden waste – 800,000 tons
• Sewage – 650,000 tons
• Straw – 6 mio tons
• Pig slurry – 6.400 mio tons
• Cattle slurry – 9.000 mio tons