New Insights in matters of Plant Nutrition, Soil Microbes and their role in Recycling of Human Excretas and regenerating Soil Fertility

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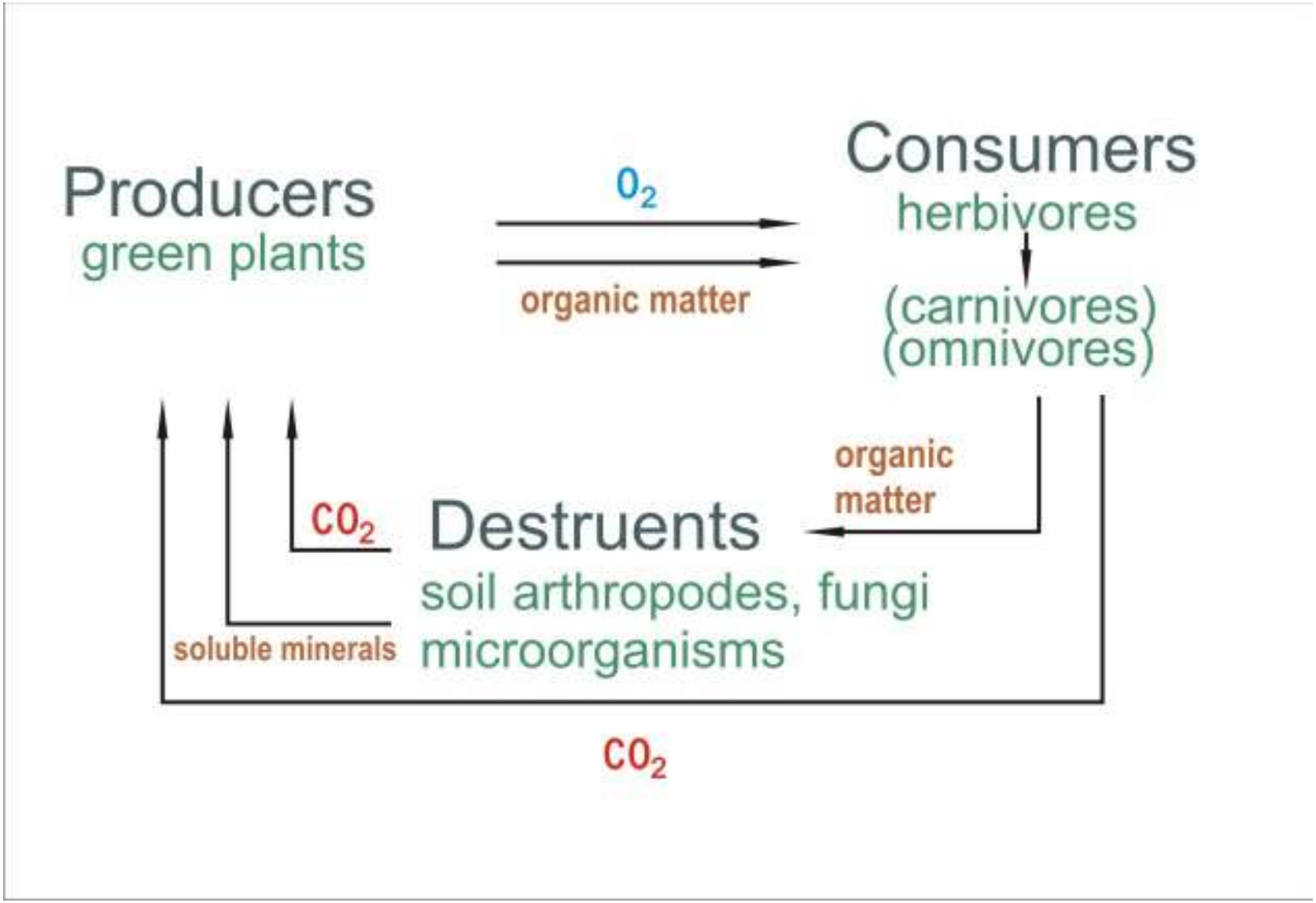
1 Natural Cycles

1.1 Conventional version



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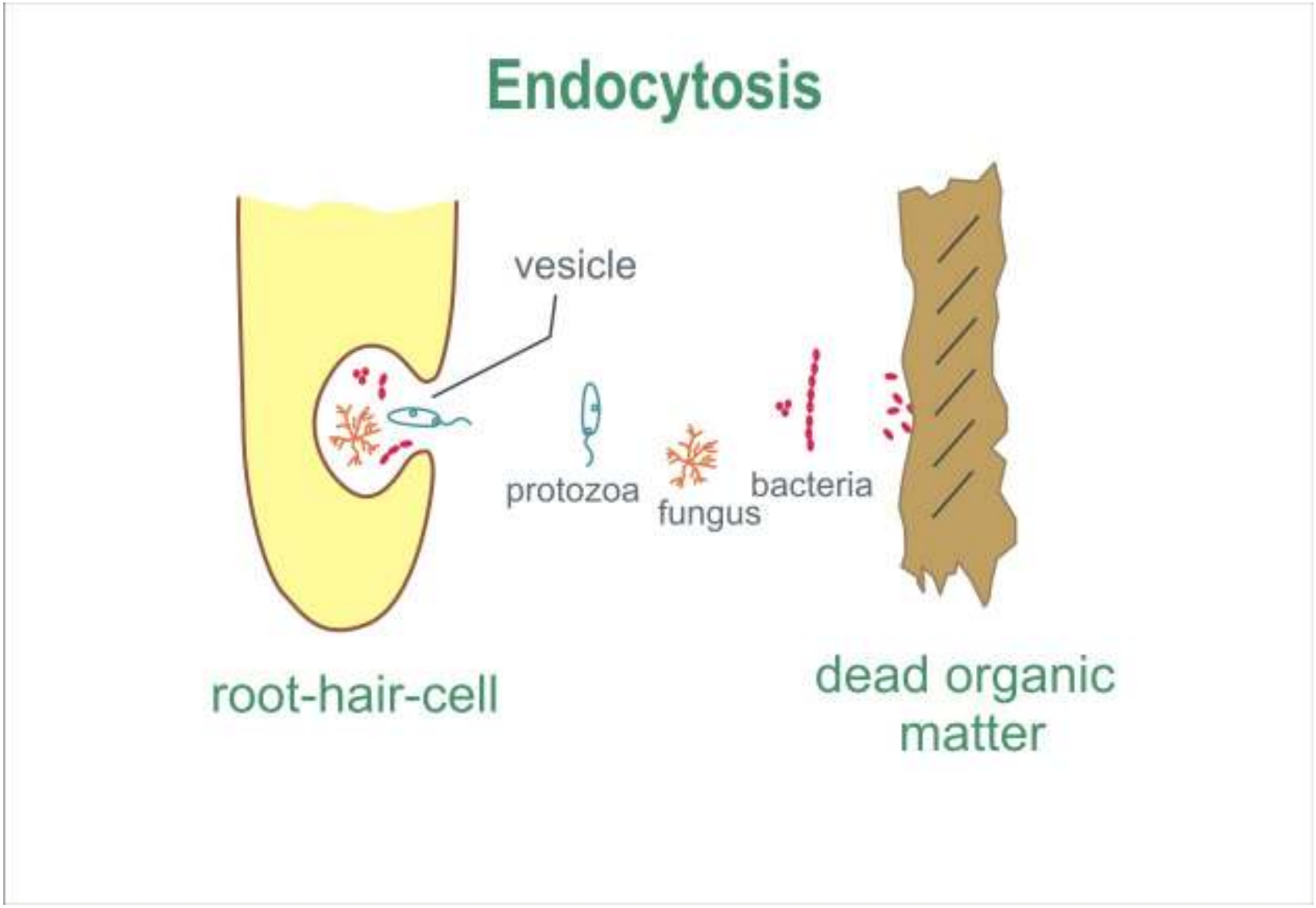
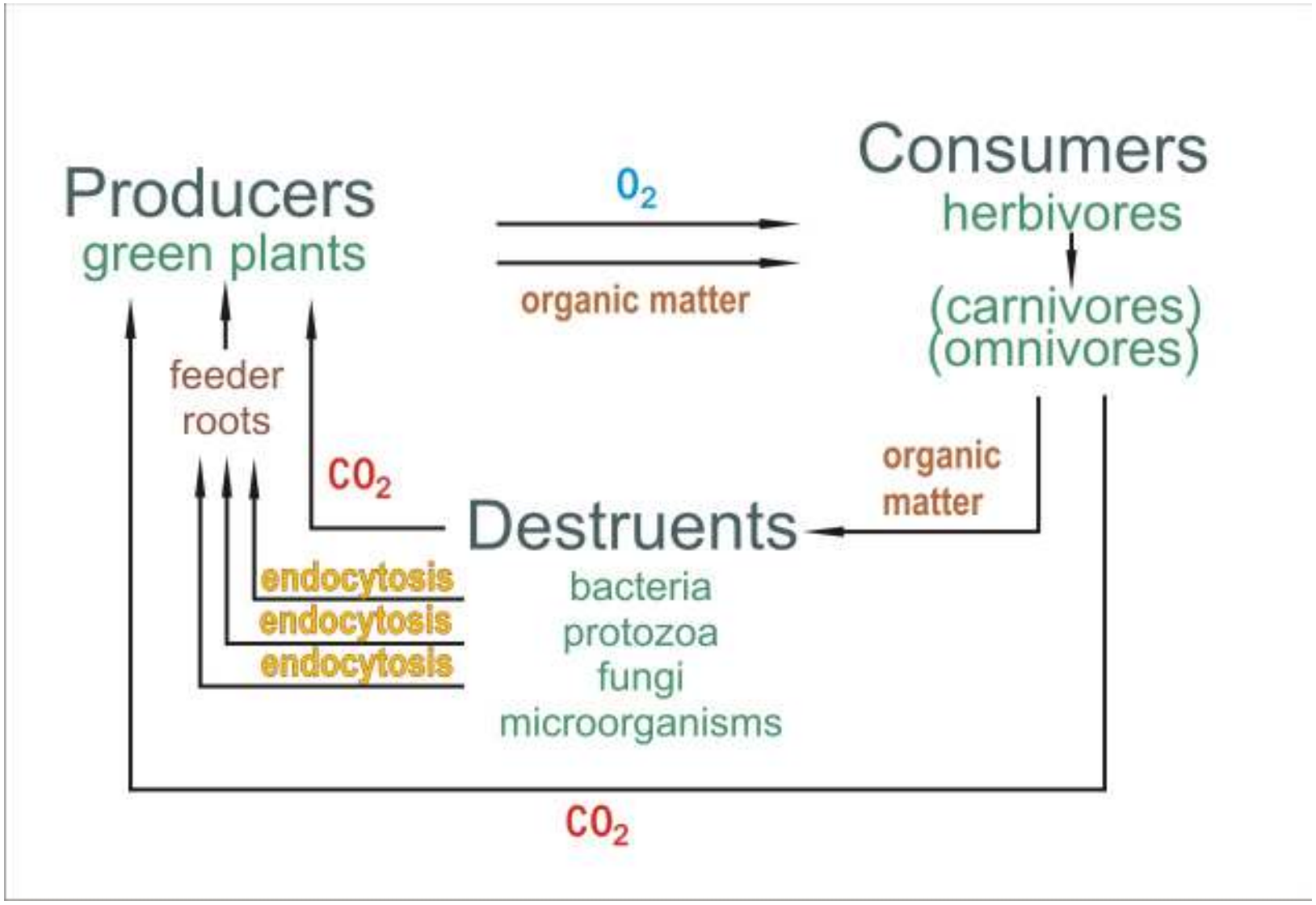
1.2 Endocytosis as the Missing Link



1.3 Ecologically sound version



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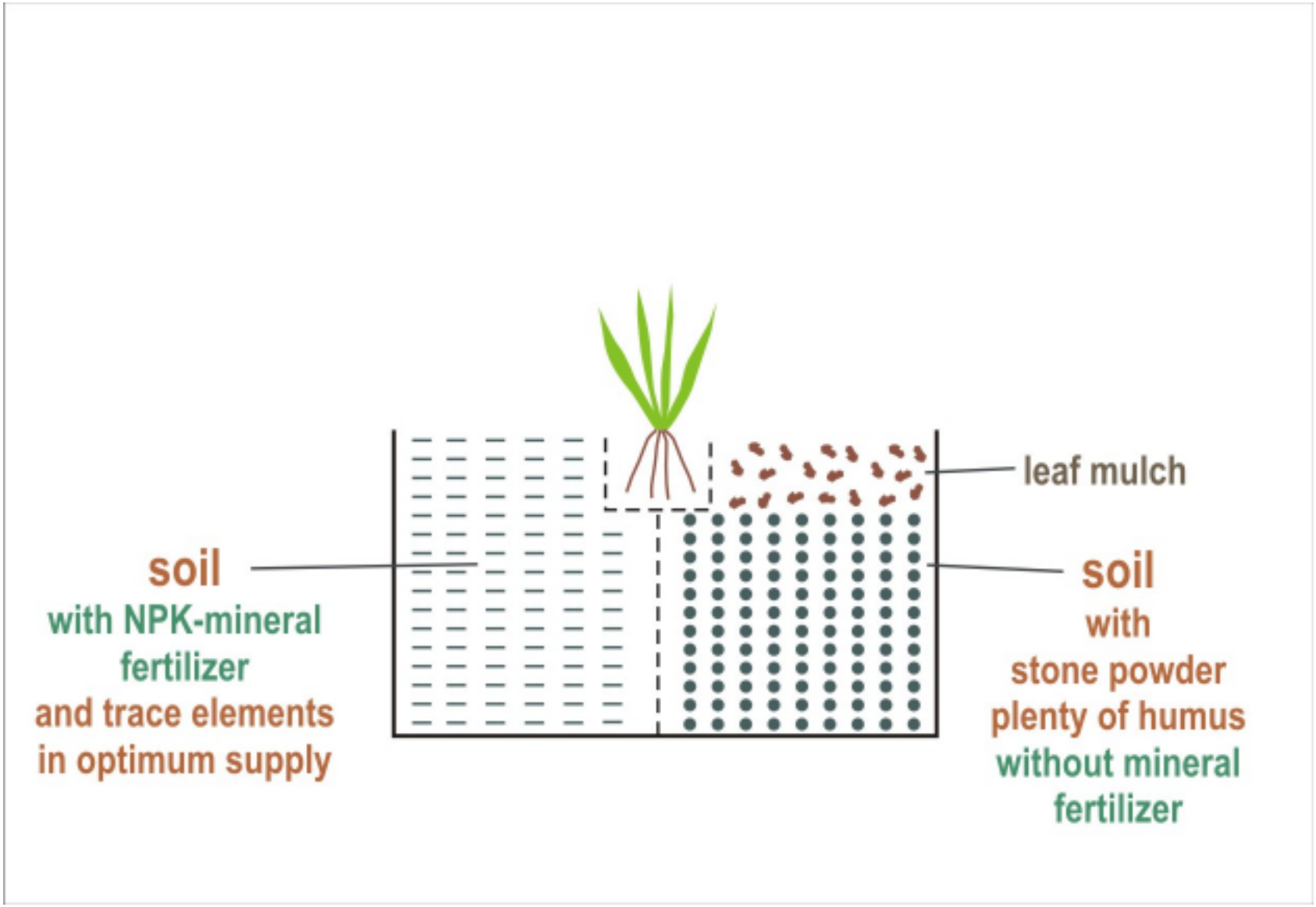
2 Simple and vivid experiments in matters of feeding plants



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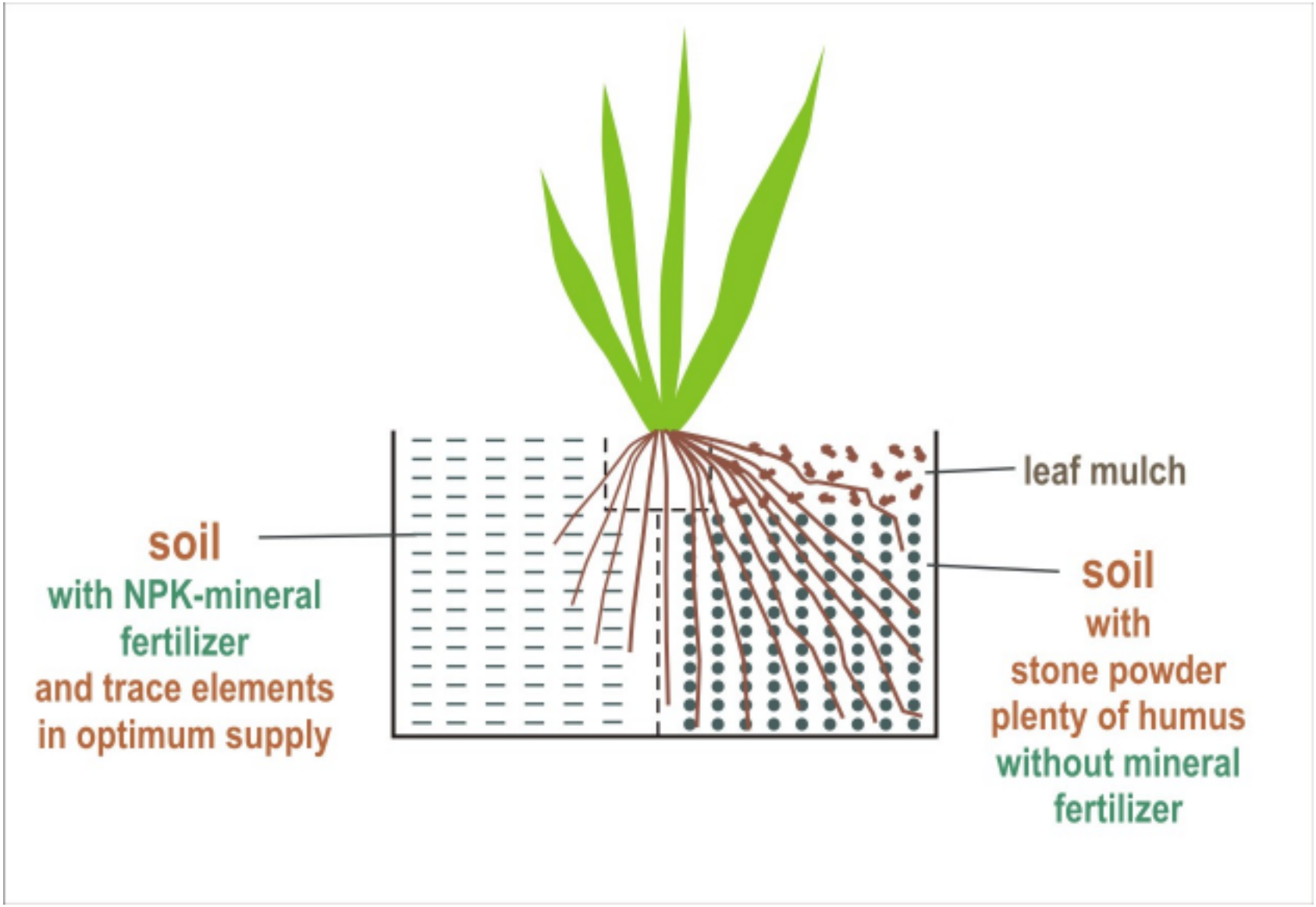

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3 Recycling Human Excreta the natural way

3.1 Plant Nutrients in Human Excretas

	urine *(500 l/year)*	faeces *(50 l/year)*	total *(kg/year)*
N	4,0	0,5	4,5
P	0,4	0,2	0,6
K	0,9	0,3	1,2

(urine amounts to ca. 90 per cent of volume of excretas
contains ca. 80 per cent of total plant nutrients)

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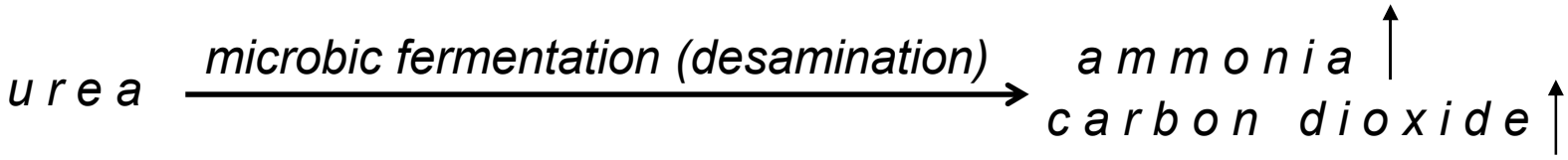
3.2 Metabolic pathways of principle constituents of urine

3.2.1 Average soluble solids of urine per person per day

organic components		***inorganic substances***	
urea	*20 – 30 g*	*sodium chloride*	*15 g*
uric acid	*0,7 g*	*phosphate*	*2,5 g*
creatinine	*0,7 g*	*sulphate*	*2,5 g*
urobiline	*traces*	*potassium*	*2,2 g*
urochrome	*traces*	*calcium*	*0,2 g*

3.2.2 Disastrous, spontaneous fermentation process



3.2.3 Selected Microbes for Inoculation

1 Bacillus subtilis

generates microbial m u c u s
aids in formation of humified substances, enzymes,
special hormones for supporting plant growth
suppresses soil-born diseases
a heat-resistant microbe

2 Bacillus mesentericus

aids in humification of crude organic matter
at lower temperatures

3.2.3 Selected Microbes for Inoculation

3 Geobacillus stearothermophilus

aids in the formation of microbial enzymes and lactic acid
decomposes potentially toxic substances
(phenolic compounds, plant resins, waxes, turpentine, complex tannins)
a heat-resistant microbe

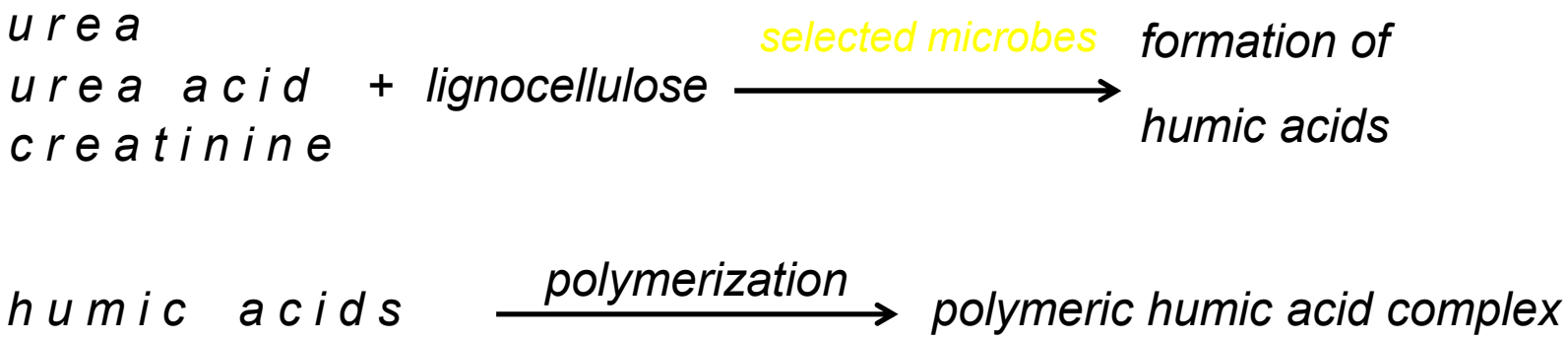
4 Azotobacter croococcum

generates organic nitrogen through biologic nitrogen fixation

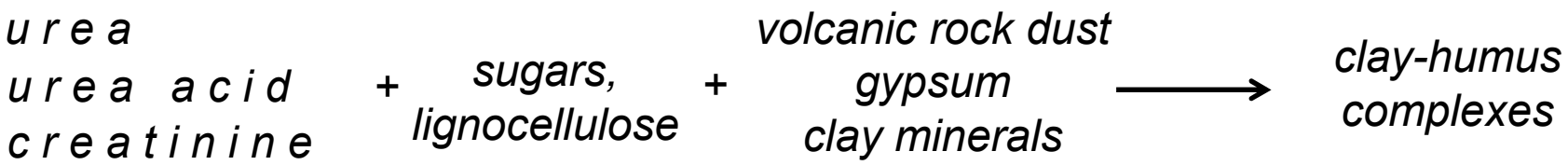
5 Lactobacillus spec.

forms lactic acid
suppresses putrescent germs
stops ineffective decomposition of complex organic matters

3.2.4 Controlled metabolization



3.2.5 Integrated approach for a controlled metabolization



desirable C/N ration for best humification between 21 and 24

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3.2.6 Composting faecal matter through Terra preta Sanitation

Faecal flora -inappropriate for soil metabolism
-incompatible with soil life

Geobacillus stearothermophilus
Bacillus subtilis
Bacillus mesentericus
Lactobacillus

steering microbes
aid in transition
to soil life

Transitional change:

Faecal matter *+ inoculated sliced-cut wood*
+ charcoal
+ loamy, volcanic soil

earth worms →

Sanitated
Terra preta

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Post- treatment procedure:

- mixing with compost derived from inoculated mixture of urine/sliced-cut wood/char coal/TP garden soil

↓

- after-ripening period (about two weeks)

↓

Ready-made compost supplying appropriate range of Plant nutrients for vegetables and fruit crops

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4 Terra preta

4.1 A few aspects of Charcoal amendments in the soil

In the 1990's a special type of soil named ***Terra preta do Indio*** was discovered which have been' invented' and developed by indigenous tribes of South America centuries ago.

Origins of black carbon : - *pyrolysis of lignocellulose*
- *enzymatic conversion of organic matter (f.i. by Aspergillus niger)*

The backbone of charcoal - polycondensed aromatic moieties

chemically and biologically persistant

physical structure: porous

when partly oxidized - nutrient retention increased

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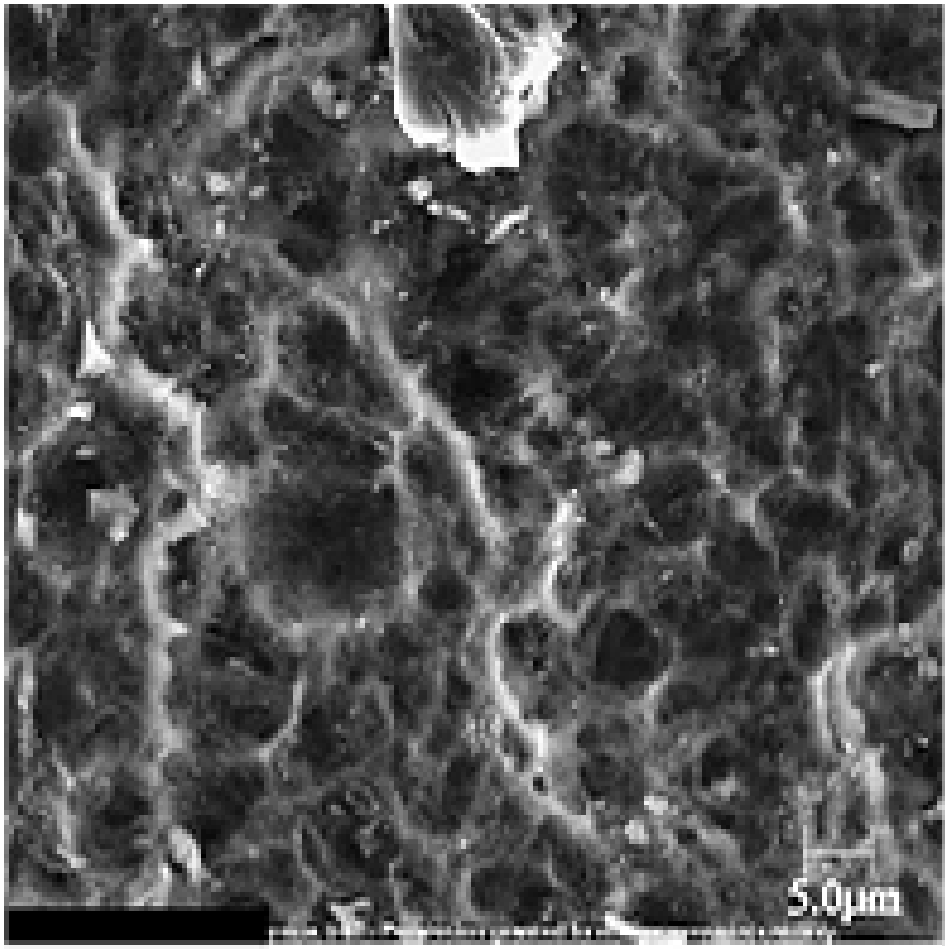

microphotograph - charcoal

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microbiologic effects*:*

- growth rates of microbes increases
- change in abundance of certain microbes:
  - *chare of fungi decreases*
  - *chare of bacterial populations increases*
  - *chare of gram-negative germs reduced*
  - *ectomycorrhizal and arbuscular mycorrhizal fungi supported*

beneficial effects for plant growth:

- higher nutrient availability in the soil (N, P, K , Ca, Zn)
- (a.o. due to higher CEC)
- crop yield significantly increased

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4.2 Characteristics

Its characteristics are virtually amazing:

1. It is characterized by several *k e y substances*, especially *coprostanol* and *charcoal particles* which indicates that it is a genuine *anthropogenic soil* and originated from the transformation of human excretas and waste
2. according to conventional theories of soil formation it mustn't occur in tropical climates (!)
3. it is extremely rich in long-lasting, persistant organic carbon (build up by stabile humus compounds)
4. is inhabited by billions of soil organisms such as *fungi, Streptomycetes, bacteria, nematods, arthropods, crustaceas, oligochaetes, soil insects a.o.*

5. stores large amounts of water

6. stores plenty of plant nutrients

7. is self-generating which means that it reproduces its very high fertility by itself : ones created in the upper soil, its seems to move downwards and increases its fertile horizons to a depth of several metres

8. resists depletion and destruction

9. retains its fertility for centuries

10. supports the establishment of the original indigenous flora and fauna and apparently complete ecosystems which often have been regarded as having gone lost forever.

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4.3 ***Potentials of T e r r a p r e t a***

1. persistant an comprehensive improvement of soils in agriculture, horticulture, forestry

2. considerable increase of soil productivity and simultaneous protection of resources

3. decisive reduction and even annihilation of soil degradation and desertification processes

4. reestablishment of a persistant vegetation in desertified areas

5. comprehensive erosion control

6. considerable increase of the capacity of water and nutrient retention

7. prevention of flooding and water erosion

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8. implementation of local water cycles and water economy

9. considerable reduction of *carbon dioxide release* by increase of carbon storage in the soil

10. decisive reduction of *methane* and *Nitrogen oxides* in agriculture

11. comprehensive improvement of recycling processes of organic matter in municipal and agricultural waste

12. cost reduction in municipal and agricultural waste management

13. reestablishment as well as increase of *biodiversity* in landscapes and threatened ecosystems

14. improvement of crop quality in the widest sense

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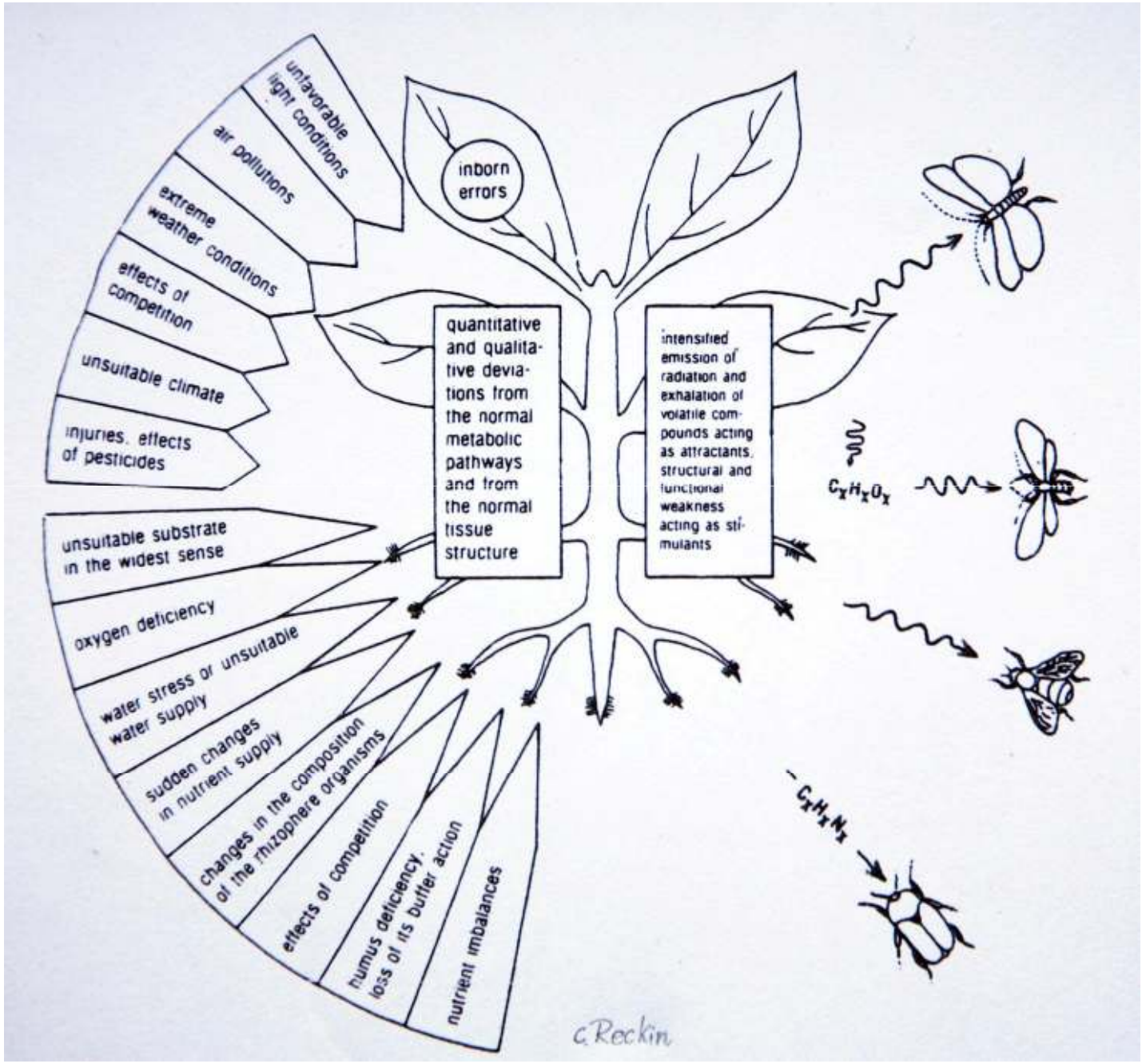
5 Pathways how plants become attacked and infested by diseases



Thank you for your attention!

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