Results and interpretation of a Dutch composting study: the fate of compostable products

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Outline

- Background of the study
- Approach (several separate activities)
- Results
- Conclusions

Background

- >20 years of debate: acceptance of compostable products in GFT
    - Waste treatment sector (Vereniging Afvalbedrijven, VA)
    - Companies producing bioplastics (Holland Bioplastics, HB)
- Unclear whether disintegration rate of certified products is sufficient for the current practice
- VA and HB: helped define research questions to provide clarity
- WFBR was commissioned by the Dutch government (Ministry EZK) to perform the research independently

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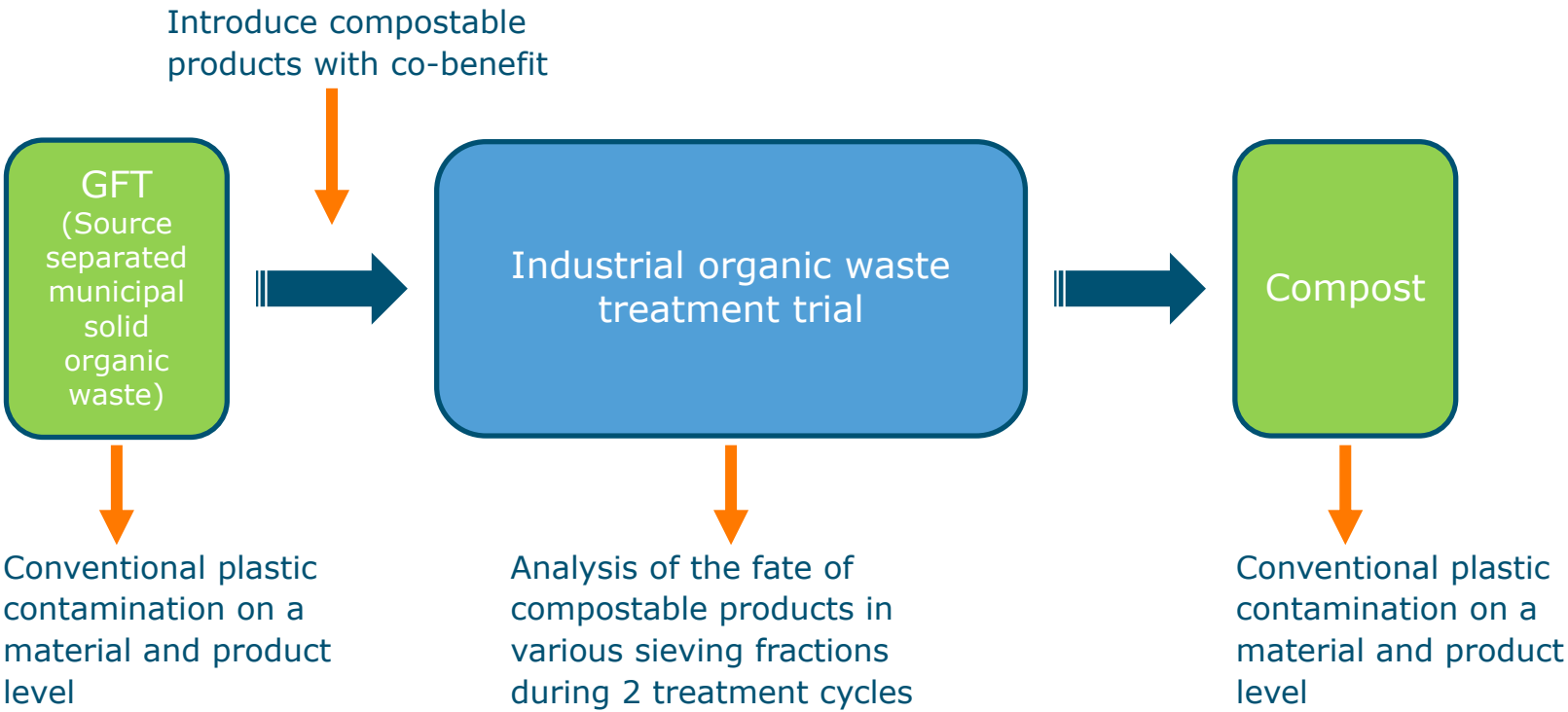
- Wageningen University + 9 Research institutes
  - Wageningen Food & Biobased Research

To explore the potential of nature to improve the quality of life

Objectives of the project

- Determine the fate of (compostable) packaging products in the current solid organic waste treatment process
    - How fast do they disintegrate in current common practice
- Determine composition of current contamination by conventional plastics in
    - GFT (source separated municipal solid organic waste)
    - Compost produced from GFT

Scope of the project

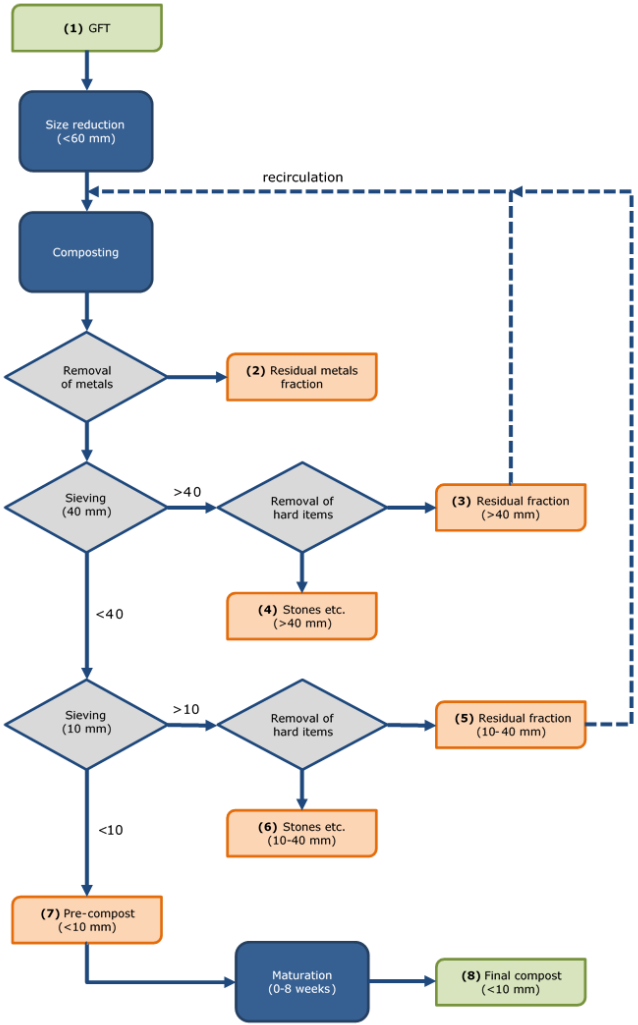


Full scale trial with compostable products

Organic waste treatment process

Selected facility (out of 21):
Van Kaathoven (St Oedenrode)

- Processes ~45 kton GFT/yr
- Tunnel composting (650 m^3)
- Residence time ~12 days
- No separation step upfront
- Recirculation possible
- Available and experienced



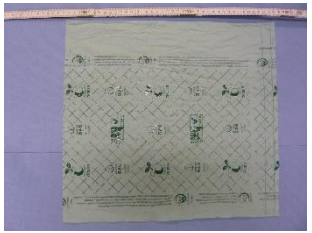
Selection of compostable products

Criteria:

- Diversity in plastic type (flex film, rigid, non wovens, labels, etc.)
- Diversity in base material/polymer (starch-blends, PLA, etc.)
- Commercially available (close to market)
- Demonstrated compostability (certified)
- Products logically related to GFT (expected co-benefit)

Overview of compostable products

A. GFT collection bag
B. GFT collection bag
C. Plant pot
D. Plant pot (cuttings)
E. Teabag (paper)
F. Fruit label
G. Coffee capsule
H. Coffee pad
I. Teabag (plastic)

A 

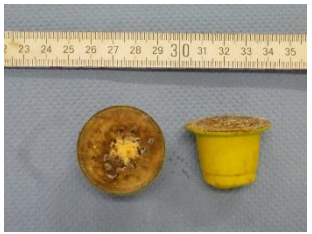
B 

C 

D 

E 

F 

G 

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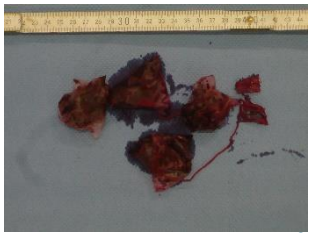
I 

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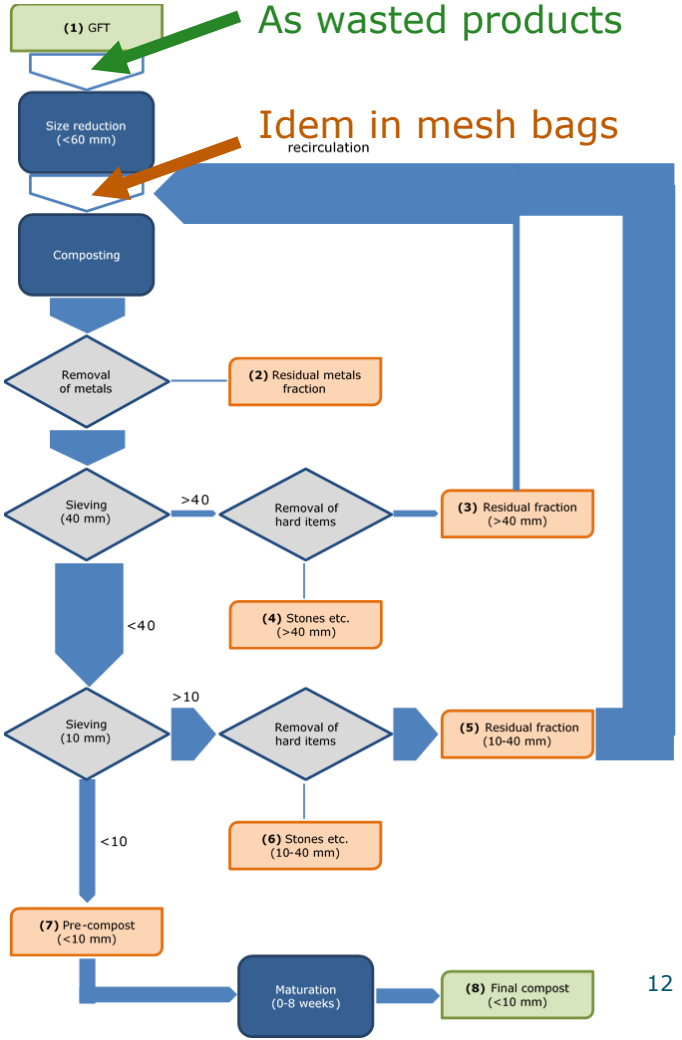
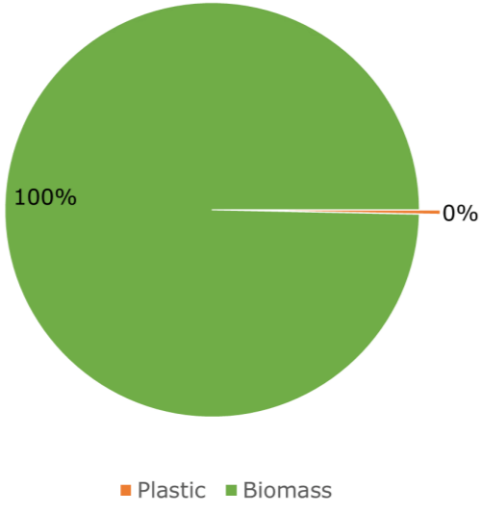
Observations waste treatment process

- 2 cycles, residence time 11 days each
- Temp. >60°C within 12 hours
- Temp. >50°C for 3 consecutive days
- No irregularities observed
- Fractions:
  - Residue 10-40 mm 20.7 ton 69%
  - Compost <10 mm 6.4 ton 21%
  - Residue >40 mm 2.6 ton 9%
  - Other fractions 0.3 ton <1%

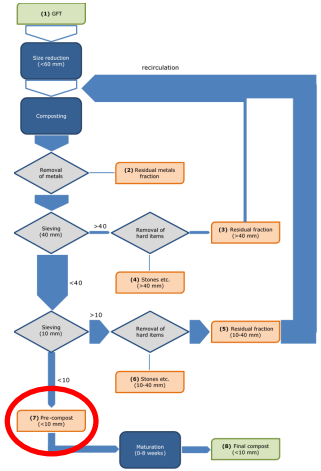


Observations full scale

- 1st Cycle: Compost fraction <10 mm (~20%)



Only conventional plastics were recovered from the samples*



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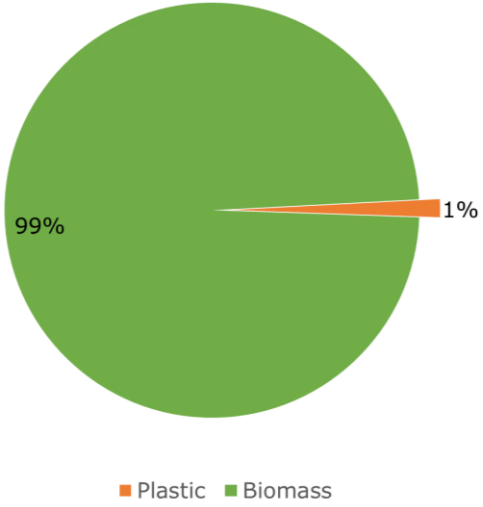
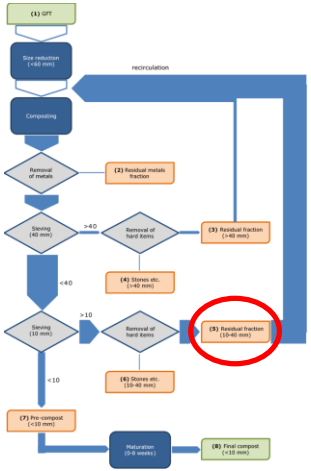
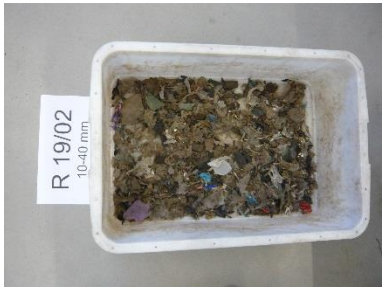
* Samples were too small to be considered a reliable representation for the whole batch

Observations full scale

- 1st Cycle: Residual fraction 10-40 mm (~70%)







All plastics recovered from sample*

Idem (close up)

Recovered test products

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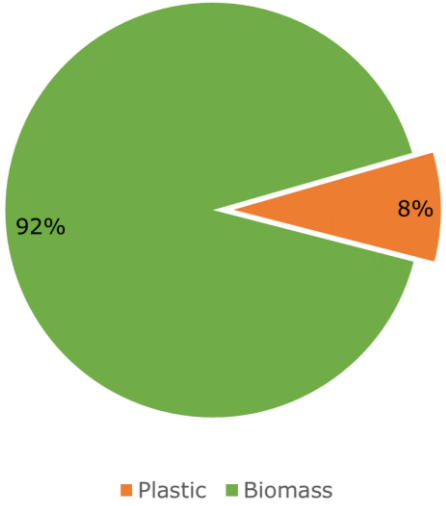
* Samples were too small to be considered a reliable representation for the whole batch

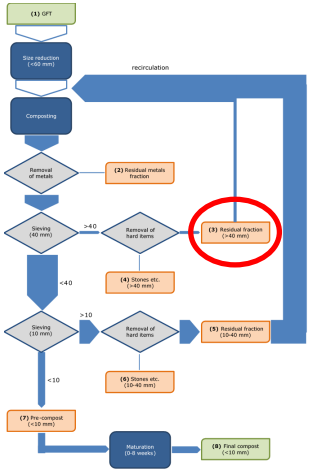
Observations full scale

- 1st Cycle: Residual fraction >40 mm (~10%)



All recovered plastics

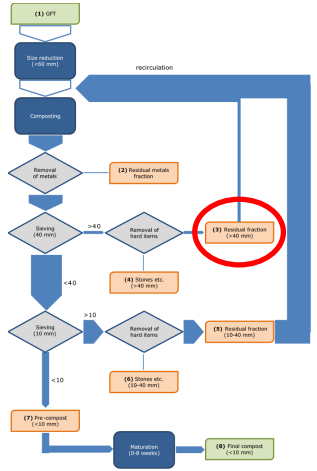
Idem (close up)



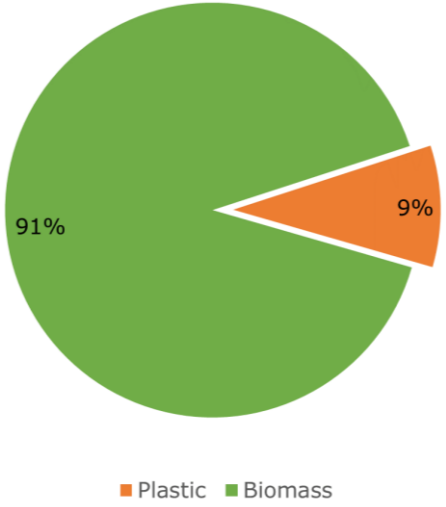
Test products recovered from the sample*

* Samples were too small to be considered a reliable representation for the whole batch

Observations full scale



- 2nd Cycle: Residual fraction >40 mm (~7%)



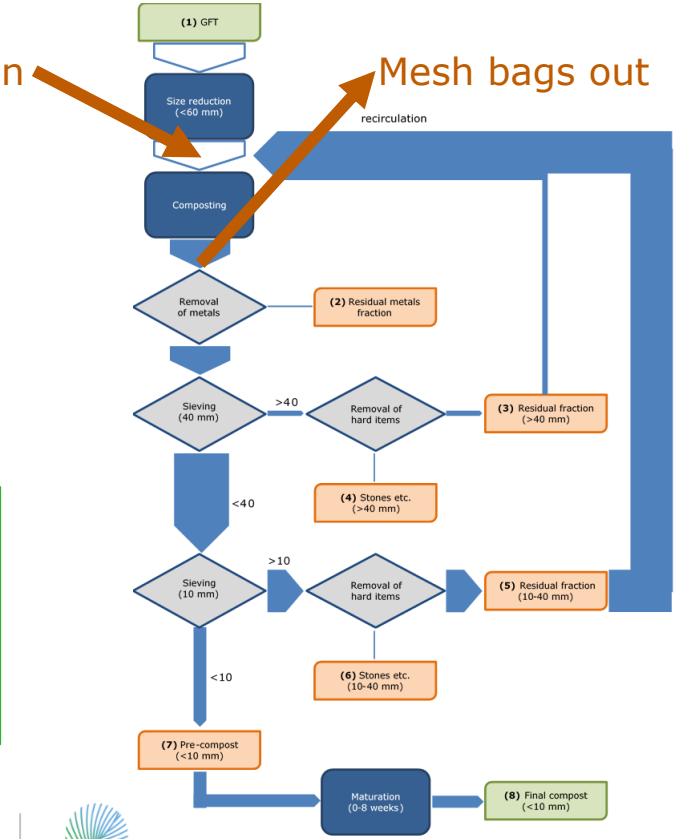
All plastics recovered from sample*

Idem (close up)

Recovered test products

* Samples were too small to be considered a reliable representation for the whole batch

Disintegration in mesh bags

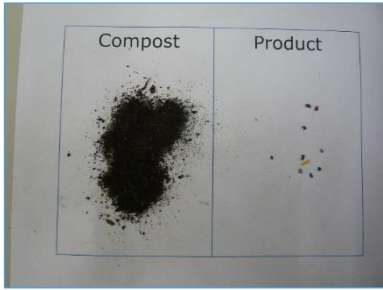


After 1st cycle:
visual inspection

After 2nd cycle:
sieving and hand picking

Disintegration in mesh bags (2nd cycle)

Examples: recovered products in various fractions (after 2 cycles)

>10 mm	8-10 mm	4-8 mm	2-4 mm	0-2 mm
				
				

Disintegration in mesh bags (2nd cycle)

Product (code)	Mass of product @ start (excl. content) (grams)	Recovery* (weight-% of start)	Disintegration* [100% – recovery] (weight-% of start)	Recovery in fraction 0-10 mm (grams)	Recovery in fraction >10 mm (grams)
GFT collection bag (A)	53	94	6	5	45
(duplicate)	53	8#	92#	n.d.	4
GFT collection bag (B)	37	100	0	2	35
(duplicate)	37	94#	6#	n.d.	35
Plant pot (C)	310	25#	75#	n.d.	79
(duplicate)	310	38#	62#	15	103
Plant pot (D)	22	1	99	0.3	0
(duplicate)	22	0	100	0	0
Teabag (E)	11	0	100	0	0
(duplicate)	11	0	100	0	0
Fruit label (F)	2.2	0	100	0	0
(duplicate)	2.2	X	*(mesh bag not recovered after 1st waste treatment cycle)*		
Coffee capsule (G)	131	91	9	70	49
(duplicate)	131	59	41	68	9
Coffee pad (H)	30	58#	42#	n.d.	17
(duplicate)	30	86	14	11	14
Tea bag (J)	14	0	100	0	0
(duplicate)	14	0	100	0	0

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Possibly loss of product due to damaged mesh bag
* Samples were not thoroughly cleaned before weighing, thus percentages are indicative only

Findings combining results: Full scale trial and mesh bags

Product (code)	Co-benefit factor (kg extra GFT / kg product)	Disintegration rate	Risk of ending up in discarded residue fractions	Risk of visual contamination of compost
GFT collection bag (A)		+	Low	Low
GFT collection bag (B)		+	Low	Low
Plant pot (C)	+++	++	Low	Low
Plant pot (D)	+++	+++	Low	Low
Teabag (E)	+++	++	Low	Low
Fruit label (F)		++	Low	Low
Coffee capsule (G)	++	+	Low	Possibly
Coffee pad (H)	+++	++	Low	Low
Teabag (I)	+++	+++	Low	Low

NB. Expert opinion based on all observations in the full scale trial and the experiments with the mesh bags for the organic waste treatment facility of Van Kaathoven in Sint Oedenrode.

Conclusions

Summarizing overall conclusions (1 of 4)

- ~20% of the tunnel output is compost (<10 mm)
- ~80% ends up in residual fractions
  - ~70% in 10-40 mm fraction (usually recirculated)
  - ~10% in >40 mm fraction (always recirculated)
  - <1% in the rest
- Main residual fractions: predominantly organic matter (consistent with short residence time) and some plastics
  - ~1% in 10-40 mm fraction, ~8% in >40 mm fraction
- Plastic fractions: predominantly non-compostable plastics

Summarizing overall conclusions (2 of 4)

- Some added products were found in residual fractions
  - In >40 mm fraction: predominantly GFT collection bags
  - Note: indicative only; meaningless to try to calculate recovery rates in this trial (high dilution factor, small samples, some amounts already present in GFT)
- Some plastics found in the compost fraction (<10 mm) but no compostable products identified

Summarizing overall conclusions (3 of 4)

- One waste treatment cycle (11 days) was sufficient for the PLA plant pot (product D) to completely disintegrate.
- Most other products needed more than 1 waste treatment cycle to fully disintegrate (including banana skin and orange peel references)
- None of selected test products are likely to cause visual contamination of the final compost by plastic residues (except for brightly coloured coffee capsules)
- None of selected test products are likely to increase the residue to be discarded by Van Kaathoven (further decomposition during recirculation)

Summarizing overall conclusions (4 of 4)

- Extrapolating findings to other organic waste treatment facilities: some selected test-products will end up in discarded residue fractions depending on:
    - Pre-treatment processes installed (sieving/grinding/...)
    - Residence time in composting phase
    - Turning frequency and impact of shear/mechanical force during pre- and post-treatment
    - Recirculation/discarding protocol for residues

Acknowledgements

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Questions?

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The full research report is available for free on: https://edepot.wur.nl/514397

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