

Ecotoxicological assessment of digestate-derived products from biowaste

K. Sensel-Gunke¹, C.-L. Ross¹, V. Wilken¹, K. Nielsen¹

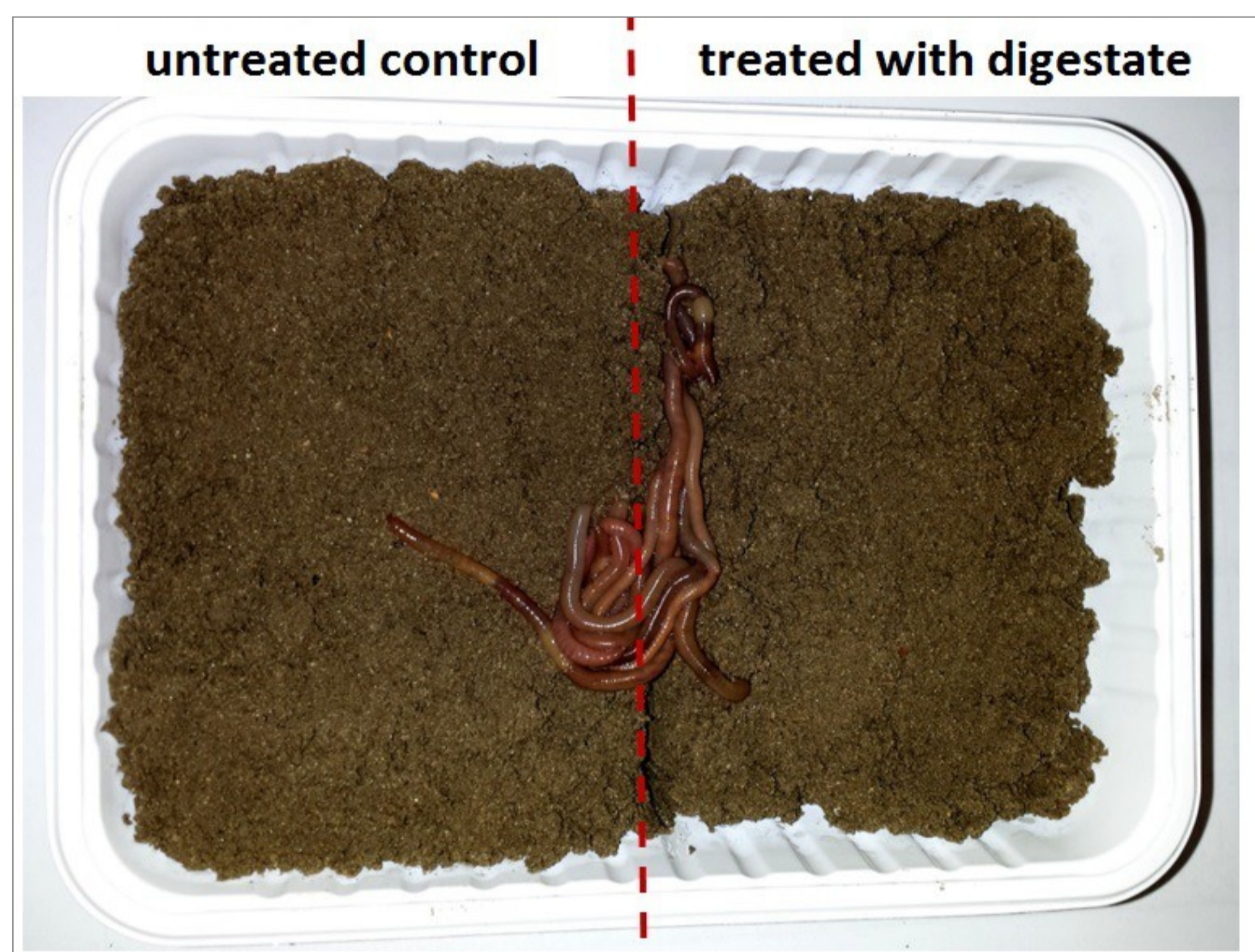
Motivation

Processed biowaste can be used as fertilizer. Because biowaste can contain high amounts of impurities, the products might have negative impacts to the environment. Standardized biological tests using living organisms are appropriate tools to investigate environmental impacts of waste-based products.

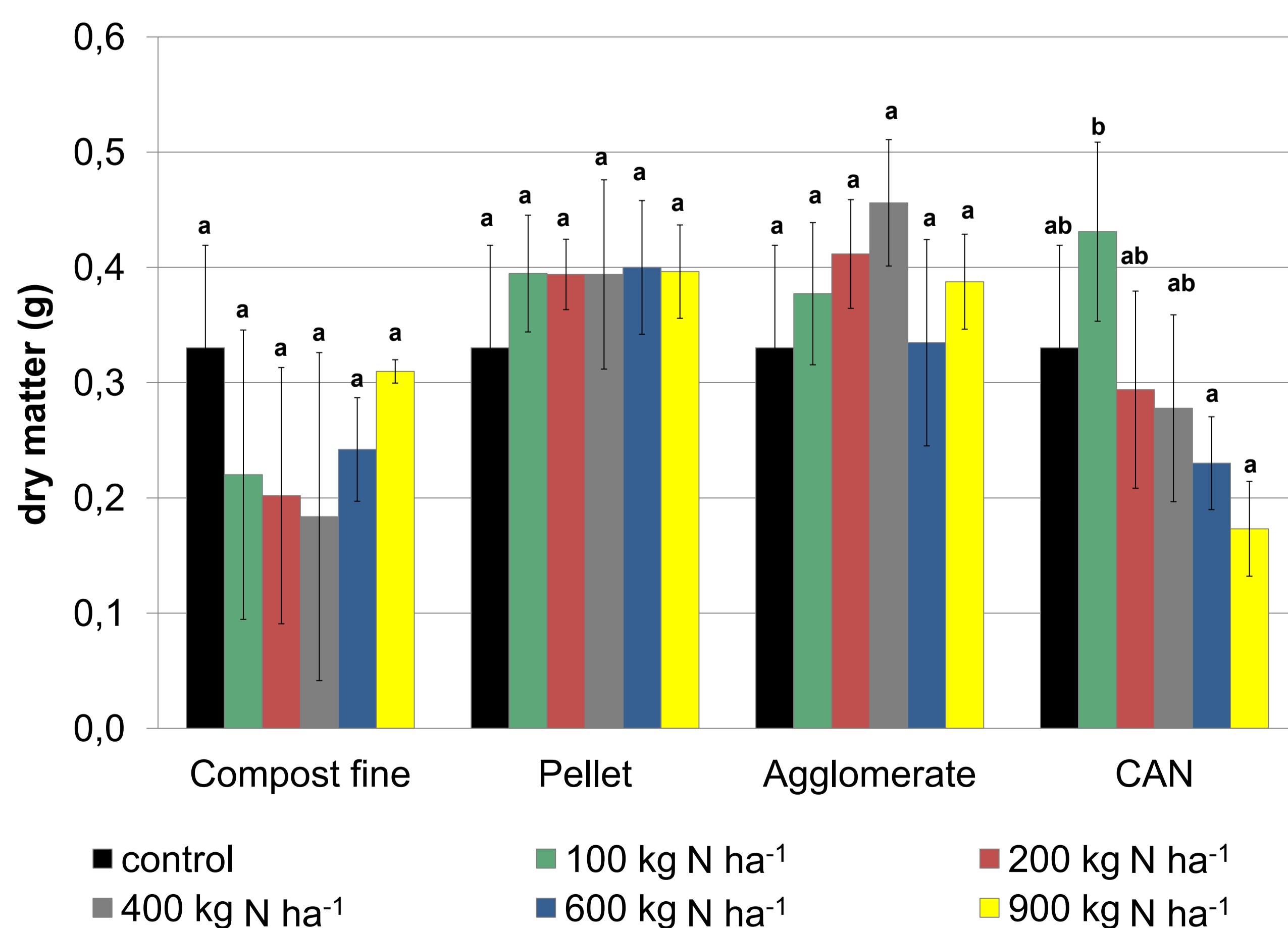
Three products were developed on the basis of anaerobically digested and subsequently composted bio-waste. Compost was sieved (compost fine) and further treated whereby two more products were achieved, a pellet and an agglomerate. The three products were tested using two bio-tests with earthworms and two with plants.

Avoidance-response test with earthworms

Method: The composts and two reference fertilizers, cow manure and calcium ammonium nitrate (CAN), were tested in two concentrations according to a nitrogen application of 200 and 400 kg ha⁻¹. The tests were conducted with two-section vessels (1 liter volume) with *Eisenia fetida* and lasted 48 hours. In each vessel ten worms had the choice between a control soil and soil mixed with compost or reference fertilizer. On the assumption of a 50:50-distribution the avoidance of the treated soil by the earthworms was calculated. The test was conducted in accordance with the International Standard Norm ISO 17512-1 (2008)



Implementation of Avoidance-Response Tests with *Eisenia fetida* in two-section vessels with treated and untreated soil

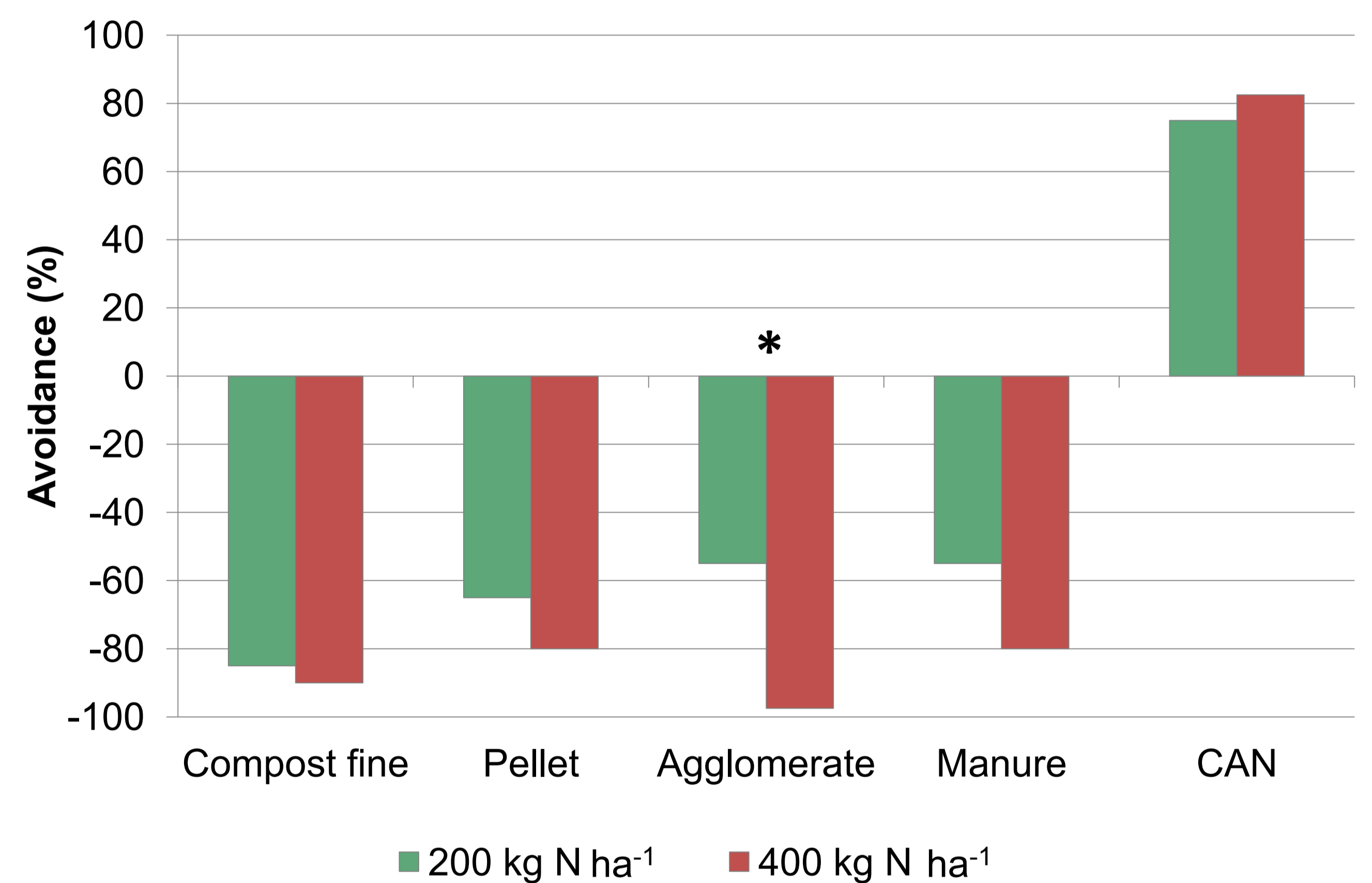


Dry matter yield [g per pot] of oat in dependence of application of different fertilizers in five concentrations compared to untreated control soil; bars of one fertilizer product marked with the same letters do not differ significantly, Tukey-Test with $\alpha = 0.05$, $n = 4$

Conclusions

- Anaerobic digestion with subsequent composting is one possible solution to produce marketable fertilizers and should be tested with different organisms.
- Within the conducted biotests also very high application rates of products did not lead to significantly negative impacts to earthworms or plants.
- Only the reference fertilizer calcium ammonium nitrate, which is a high potential nitrogen fertilizer, lead to negative impacts at highest application rates.

Results: In the tests all three soils treated with compost-products and also soil mixed with cow manure were preferred compared to untreated control soil. A significant difference between the two tested concentrations was found only once for agglomerate. An avoidance response of the earthworms was only detected for the reference substance calcium ammonium nitrate.



Avoidance of earthworms in reaction towards different fertilizers and their concentration; $n = 4$; significant differences between low and high concentration are marked with *

Phytotoxicity test with oat and turnip rape

Methods: The tolerance of plants against the composts was tested in a pot experiment with dicotyledonous and monocotyledonous plant species (turnip rape and oat) following the International Standard Norm ISO 11269-2 (2012). The test detects effects on the emergence and early growth of plants. For each pot soil was mixed with one of the three compost-products or calcium ammonium nitrate as reference fertilizer in concentrations according to 100, 200, 400, 600 and 900 kg N ha⁻¹. Untreated soil was used as control.

Results: Regarding the digestate-products there were no significant reductions of dry matter yield compared to untreated control soil for dicotyledonous plants (results not shown) and only a slight negative effect of sieved compost for monocotyledonous plants. In most cases there was no clear dose response either. Only the reference fertilizer calcium ammonium nitrate lead to heavy responses with significant yield reductions at very high (and for field application unusual) dosages.