Assessment of tailor-made blends of recycling-derived fertilizers in pot cultivation of *Spinacea olaracea*

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INTRODUCTION

- **Biomass streams** (i.e. animal manure, sewage sludge, food and other organic wastes) are **rich sources of agricultural nutrients**, but their current use is inefficient.
- The nutrients from these biomass streams are processed for use in agriculture, but they have a **highly variable nutrient composition**, making them undesirable to the end-users.
- To **mitigate the nutrient variability** and to stimulate an exchange of nutrients across regions of imbalance, **blending of recycling-derived fertilizers** is suggested as a possible solution.
- This **study aims at developing and assessing tailor-made fertilizer blends by** pot cultivation of *Spinacea olaracea* and a soil incubation experiment to test N dynamics of the blends.

EXPERIMENTAL SET-UP POT EXPERIMENT

- **21 recycling-derived fertilizer products** were collected and characterized for their physicochemical properties.

Table 1. Mean values of total nitrogen (N), phosphorus (P) and potassium (K) content in 21 collected fertilizers on fresh weight basis.

Fertilizer	N (g/kg)	P (g/kg)	K (g/kg)	Fertilizer	N (g/kg)	P (g/kg)	K (g/kg)
AN	82	0.001	0.04	AW 1	107	<0.0003	<0.002
AS	39	<0.0003	0.1	AW 2	168	<0.0003	<0.002
Pig urine	6	<0.0003	3	MC	3	0.1	2
Ash 1	<0.9	48	7	CaE	5	1	10
Ash 2	<0.9	39	70	Compost 1	26	8	15
Ash 3	<0.9	5	9	Compost 2	14	7	7
Ash 4	<0.9	3	16	Compost 3	22	7	7
Struvite 1	53	50	0.2	Compost 4	17	6	16
Struvite 2	53	90	9	LF digestate	5	0.3	3
P - poor SF	6	1	0.3	LF manure	3	0.1	3
Digestate	5	3	4				

AN = ammonium nitrate, AS = ammonium sulphate, SF = solid fraction, AW = ammonia water, MC = mineral concentrate, CaE = concentrate after evaporation, LF = liquid fraction, 1 or 2 = different producer

- On the basis of the results from the analyses and considering the required NPK ratio for *Spinacea olaracea* (8:1:8), **two blends** were prepared:

  Blend 1: ammonium nitrate + concentrate after evaporation

  Blend 2: ammonia water 2 + concentrate after evaporation

- **Seven treatments** were tested with **four replicates** per treatment:

I. Blank (i.e. no fertilization)
II. Control (synthetic NPK fertilizer (calcium ammonium nitrate (CAN) for N, triple superphosphate for P, and potassium sulphate for K))
III. Ammonium nitrate + synthetic PK fertilizer
IV. Ammonia water 2 + synthetic PK fertilizer
V. Concentrate after evaporation + synthetic N fertilizer
VI. Blend 1
VII. Blend 2

- **Two fertilization dosages**: i) N–fertilizer advice (200 kg N/ha) and ii) N–fertilizer advice - 50 % (i.e. 100 kg N/ha).
- The moisture content was maintained at 85% until germination of seeds, and later brought down to 70% water holding capacity (WHC).
- Harvest to be done after 60 days of growth.
- Plant and soil samples to be tested for macro- and micro-nutrient content, and fresh and dry weight.

***Figure 1. Experimental set-up in a randomized block design. Image taken after 45 days of* growth.**

DETERMINING N-MINERALIZATION AND RELEASE : EXPERIMENTAL SET-UP NITROGEN INCUBATION EXPERIMENT

- **Nine treatments** tested in six sampling moments with **three replicates** per moment, and each sampling to be performed at an interval of 20 days.
- The treatments being assessed are:

I. Blank (i.e. no fertilization)
II. Control (i.e. CAN)
III. Pig urine
IV. Ammonium sulphate
V. Ammonium nitrate
VI. Ammonia water 2
VII. Concentrate after evaporation
VIII. Blend 1
IX. Blend 2

Figure 2. Setting up of the N-incubation experiment.

FUTURE RESEARCH PERSPECTIVES

- Data processing and further assessments via pot experiments with other crop cultivars to study if tailor-made blends exhibit a similar performance in comparison to synthetic mineral fertilizers.
- Market uptake potential of the blends with respect to legislative barriers and end-user demands.
- Incubation tests to determine nutrient losses by atmospheric emissions of NH_3, N_2O, and CO_2 from blends.

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