Assessment of recycling-derived fertilizers and tailor-made blends in laboratory and field

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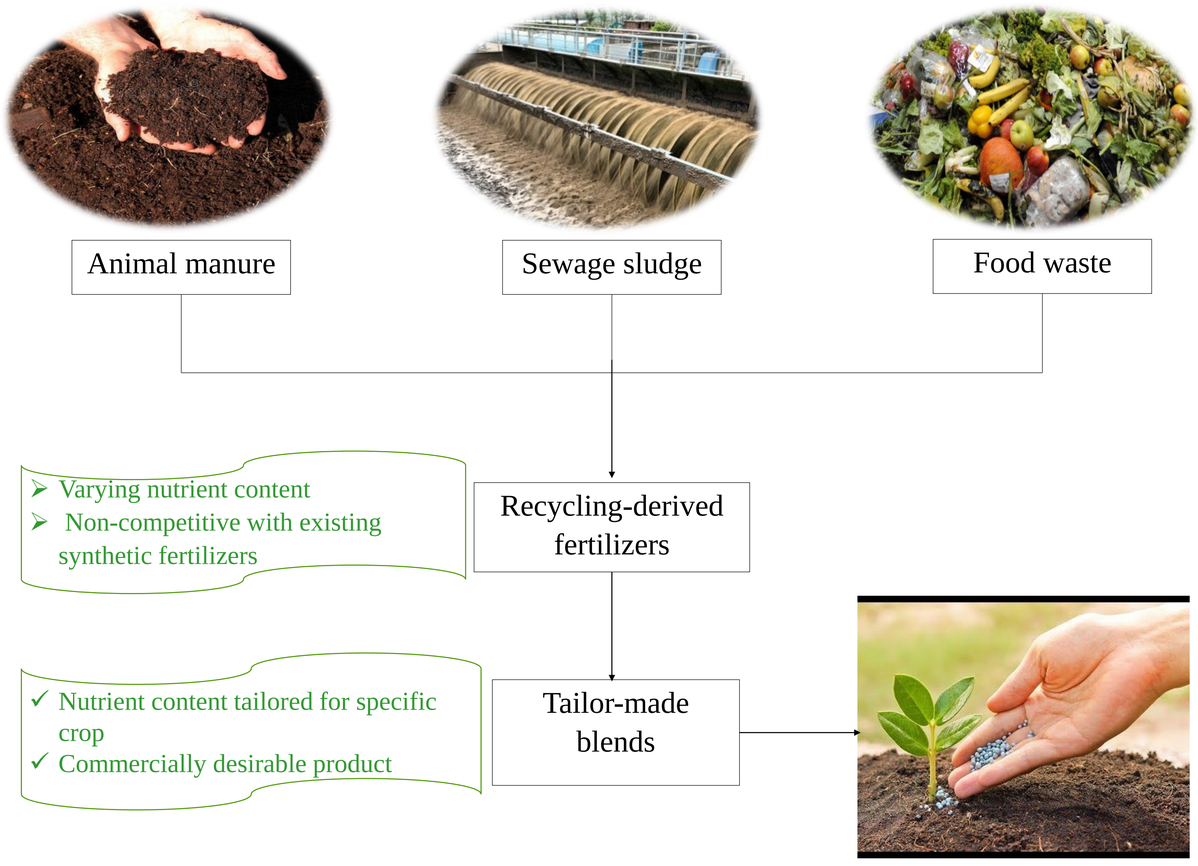
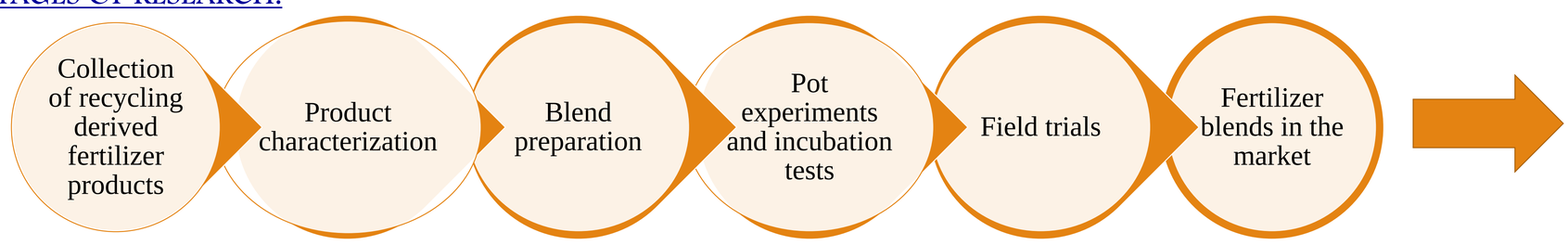
PROBLEM AND OBJECTIVES:

- Excess of animal manure, sewage sludge, and food waste causes nutrient surplus in some regions, whereas other regions face a nutrient shortage sometimes, resulting in nutrient imbalance.
- Animal manure, sewage sludge, and food waste can be recycled into valuable derivatives that can serve as replacements for synthetic fertilizers.
- The nutrient concentration in recycled derivatives is variable, making them non-competitive with existing commercial fertilizers.
- The problem of nutrient imbalance can be mitigated by stimulating an exchange of nutrients from areas of surplus to areas of shortage.
- The issue of nutrient variability in recycled derivatives can be resolved by developing tailor-made fertilizer blends from recycled fertilizers, with specific nutrient ratios desirable for the farmers in particular regions of North-West Europe.
- To achieve this aim, an implementation of effective communication with the stakeholders (producers, farmers, policy makers etc.) will be crucial.

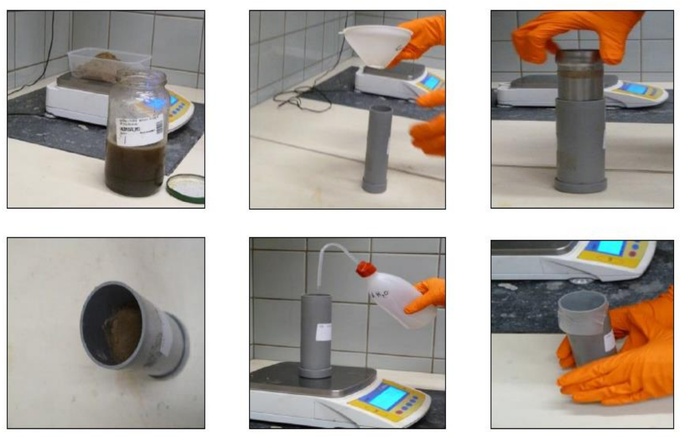


STAGES OF RESEARCH:



LAB-SCALE EXPERIMENTS:

- Physico-chemical characterization of 21 recycling-derived fertilizers including ashes, struvite, compost, digestate derivatives, ammonium sulphate, ammonium nitrate, pig urine, mineral concentrate, and ammonia water.
- Preparation of tailor-made blends suitable for specific crop requirements.
- Incubation experiments to assess N mineralization and N release potential.
- Pot experiments to examine the effectiveness of tailor-made blends in comparison to synthetic mineral fertilizers



Experimental set-up of N incubation experiment for determination of N mineralization and N release

Pot experiments to test the recycling-derived fertilizers and tailor-made blends

POT EXPERIMENT:

- Pot experiments with spinach (*Spinacea olaracea L.*) carried out to assess the effectiveness of tailor-made blended fertilizers relative to the synthetic mineral fertilizers.
- Same soil as field experiments (in Lichtervelde, Belgium)
- Blends prepared after evaluation of results from product characterization.
- Seven treatments to be tested with 4 replicates per treatment. The treatments of interest are:

I. Blank (no fertilization)
II. Control 1 (Synthetic NPK)
III. Ammonium nitrate + Synthetic PK
IV. Ammonia water 2 + Synthetic PK
V. Concentrate after evaporation + Synthetic N
VI. Ammonium nitrate + Concentrate after evaporation (Blend 1)
VII. Ammonia water 2 + Concentrate after evaporation (Blend 2)

- Two dosages for all treatments except blank. i.) N – fertilizer advice ~ 50 % and ii.) N – fertilizer advice

RESULTS OF PRODUCT CHARACTERIZATION (NPK VALUES):

Fertilizer	TN (g/kg)	TP (g/kg)	TK (g/kg)	Fertilizer	TN (g/kg)	TP (g/kg)	TK (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	LFD	5	0,3	3
P ~ poor SF	6	1	0,3	LFM	3	0,1	3
RD	5	3	4				

Mean values based on fresh weight of product, where, TN = total nitrogen, TP = total phosphorus, TK = total potassium, AN = ammonium nitrate, AS = ammonium sulphate, SF = solid fraction, RD = raw digestate, AW = ammonia water, MC = mineral concentrate, CaE = concentrate after evaporation, LFD = liquid fraction of digestate, LFM = liquid fraction of manure

FIELD EXPERIMENTS:

- Field trials in Flanders on-going in collaboration with Inagro.
- Rotation March/April 2019 (maize), 2020 (spinach + corn/cover crop).
- Seven treatments to be tested with 4 replicates per treatment. The treatments of interest are:

I. Blank (no fertilization)
II. Control 1 (Synthetic P and K fertilizer)
III. Control 2 (Synthetic NPK fertilizer)
IV. Animal manure
V. Ammonium nitrate
VI. Ammonium sulphate
VII. Pig Urine

- 3 dosages for all treatments except blank and control 1. i.) N – fertilizer advice ~ 60 %, ii.) N – fertilizer advice ~ 30 % and, iii.) N – fertilizer advice

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