Soluble Phosphate Salts and Organophosphate Esters from Agricultural Biowaste

Dr Kirill Nikitin
Dr Simon Hodge

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Our Interdisciplinary Team

Dr Kirill Nikitin PI
- Lead Inventor of the new DOC technology
- Organic and physical chemistry

Dr Simon Hodge Co-PI
- Sustainable and organic agriculture. Environmental ecology, plant biology and organic farming

Prof. Declan Gilheany
- Co-inventor of DOC technology

Dr R. Choudhary
- Post doctoral scientist

Mr Peter Mooney
- Societal Impact in Ireland
- Dawn Meats Group

Mr Ziv Kohav
- Global Impact
- ICL Group

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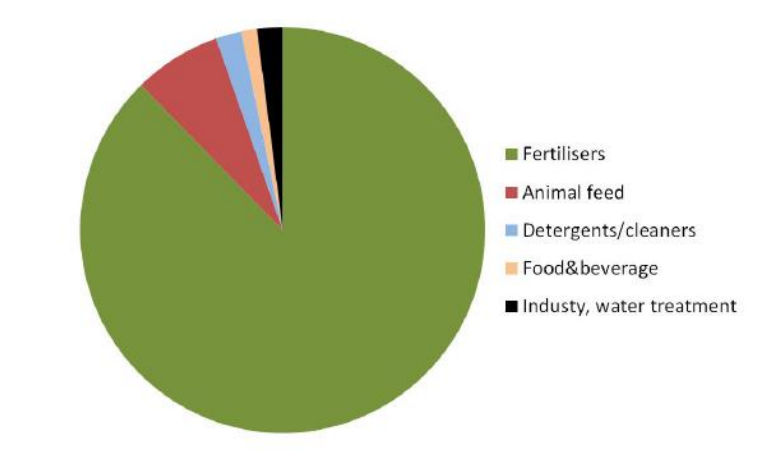
The future of Phosphorus - an Uncertain road?

Challenge

- Supply Chain Risk
- Finite Resource
- Insufficient phosphate recycling
- Waste regulations increasingly strict



Actions

- Phosphates on the EU CRM list
- ESPP created in 2013
- ESPC forums
- Over 40 emerging technologies

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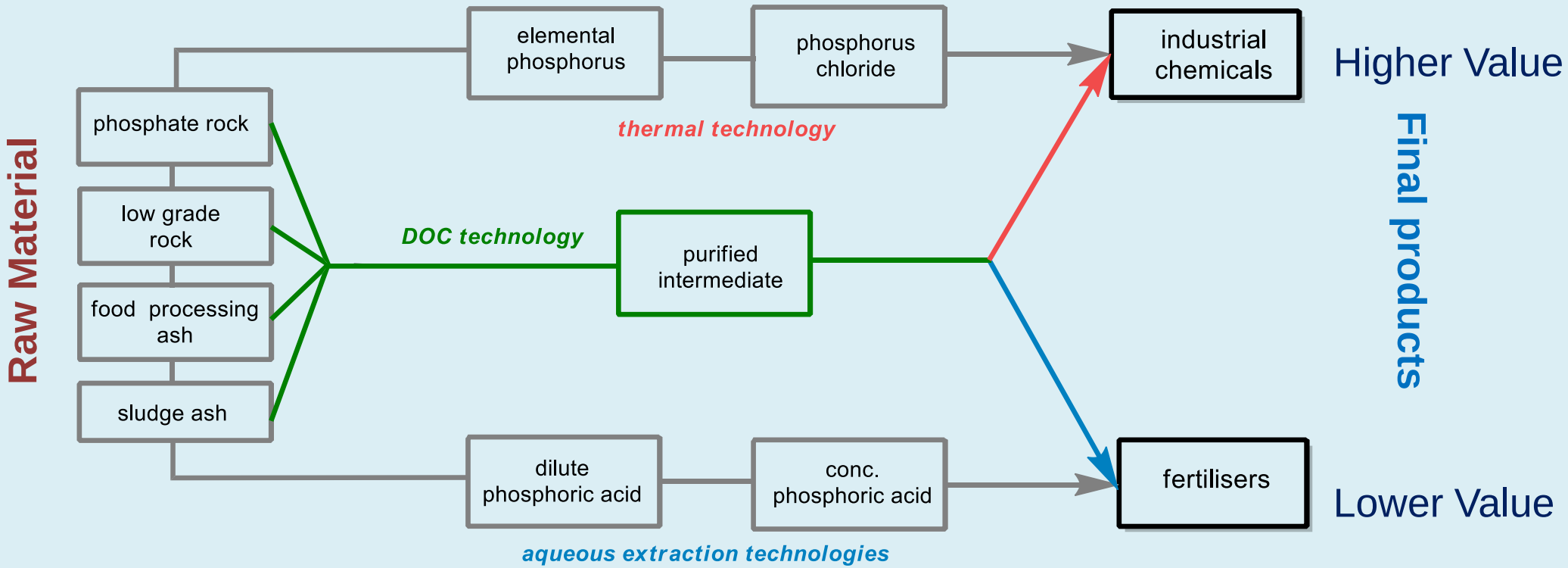
DOC: a Novel Phosphorus recovery Technology



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Why do we need another Technology ?

Technological Benefits

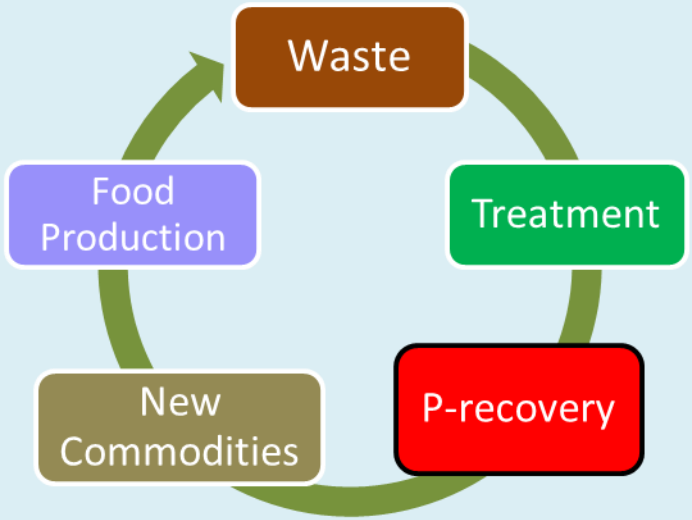
- No acids required
- Moderate temperatures and heat recycling
- No extra CO_2 generated
- Phosphorus chemicals from solid ore/waste

Raw Materials

- Recovery from most dry solid sources
- Rock and low-grade rock
- Municipal, bone, manure ashes
- Base and heavy metal Tolerance

Products and Outputs

- Phosphoric acid
- Phosphate salts MAP, DAP etc.
- Phosphate esters e.g. TOP
- Industrial chemicals e.g. TPP
- Environmental benefits
- Leads to circular economy



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Initial Tests: Hydroxyapatite

$Ca_5OH(PO_4)_3$

PO_4^{3-} —DOC→ volatile P(V) species

- Efficient single batch extraction of phosphate
- Quantitative recovery in repeated runs
- Selective conversion to a volatile product

☑

- Elevated Temperature
- Extended Extraction time
- Highly corrosive medium

☒

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Phosphate-rich Materials

Material		Source	P, %	P-Recovery Results
Phosphate rock		Siberian Apatite	18	Low
Bone meal ash		Dawn Meats, Ireland	16.3	Med/ High
Sewage Sludge Ash		ICL Group, Netherlands SNB	12	Med/ High
Fish Bone ash		BioMarine, Ireland	17.5	High
Vivianite		Kemira, Finnland	11.7	Med/ High

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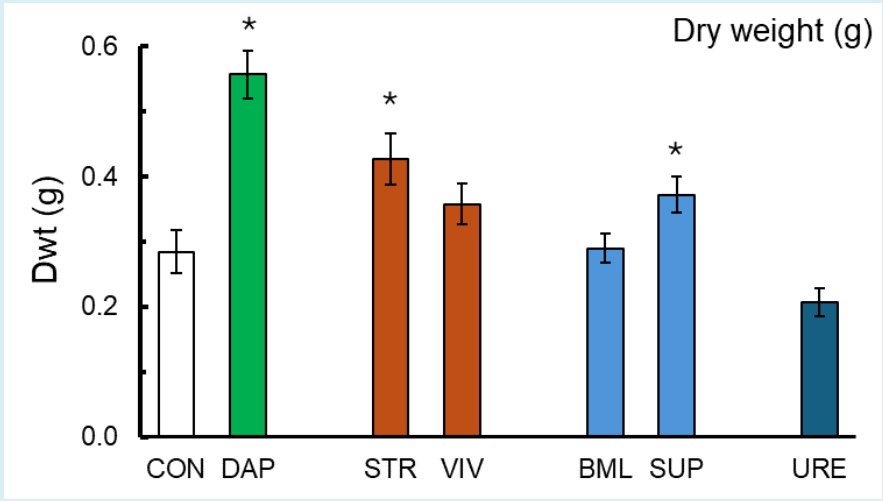
Successful Greenhouse Trials of DOC Fertilizer

- Barley seedlings. Harvested 5 weeks after sowing.
- DAP synthesized via DOC chemistry
- Compared with: Control, VIV, STR, SUP, BML
- All applied at equivalent 60 kg P/ ha as powder top dressing
- Urea used as control for ammonium in DAP

- Our DAP produced shoot dwt 2-times obtained in the control
- STR and SUP also sig increased shoot growth
- But our DAP still performed better than STR and SUP



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Reaching out to the P-community

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DAWN MEATS

Glanua
For a cleaner planet

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bii BIO-MARINE INGREDIENTS IRELAND

WICKLOW

Thank you !

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