Applicazioni di nanotecnologie nel settore primario: Nanofertilizzanti

Luca Marchiol, Enrico Braidot

Udine, Sala atti

3 aprile 2019

PROGETTO CONDIVISO

UNIVERSITÀ DEGLI STUDI DI UDINE hic sunt futura

FONDAZIONE FRIULI

Responsabile scientifico della ricerca

Luca Marchiol – PA, DI4A
ssd AGR/02 Agronomia e Coltivazioni Erbacee
Coordinatore LM “Analisi e Gestione dell’Ambiente” interateneo UD-TS
Dottorato “Ambiente e Vita” interateneo TS-UD

→ Plant ecophysiology vs abiotic stress (trace metals)
→ Phytoremediation
→ Engineered nanomaterials vs plants/crops

ISI papers 40
H-index 12
Citations 1351

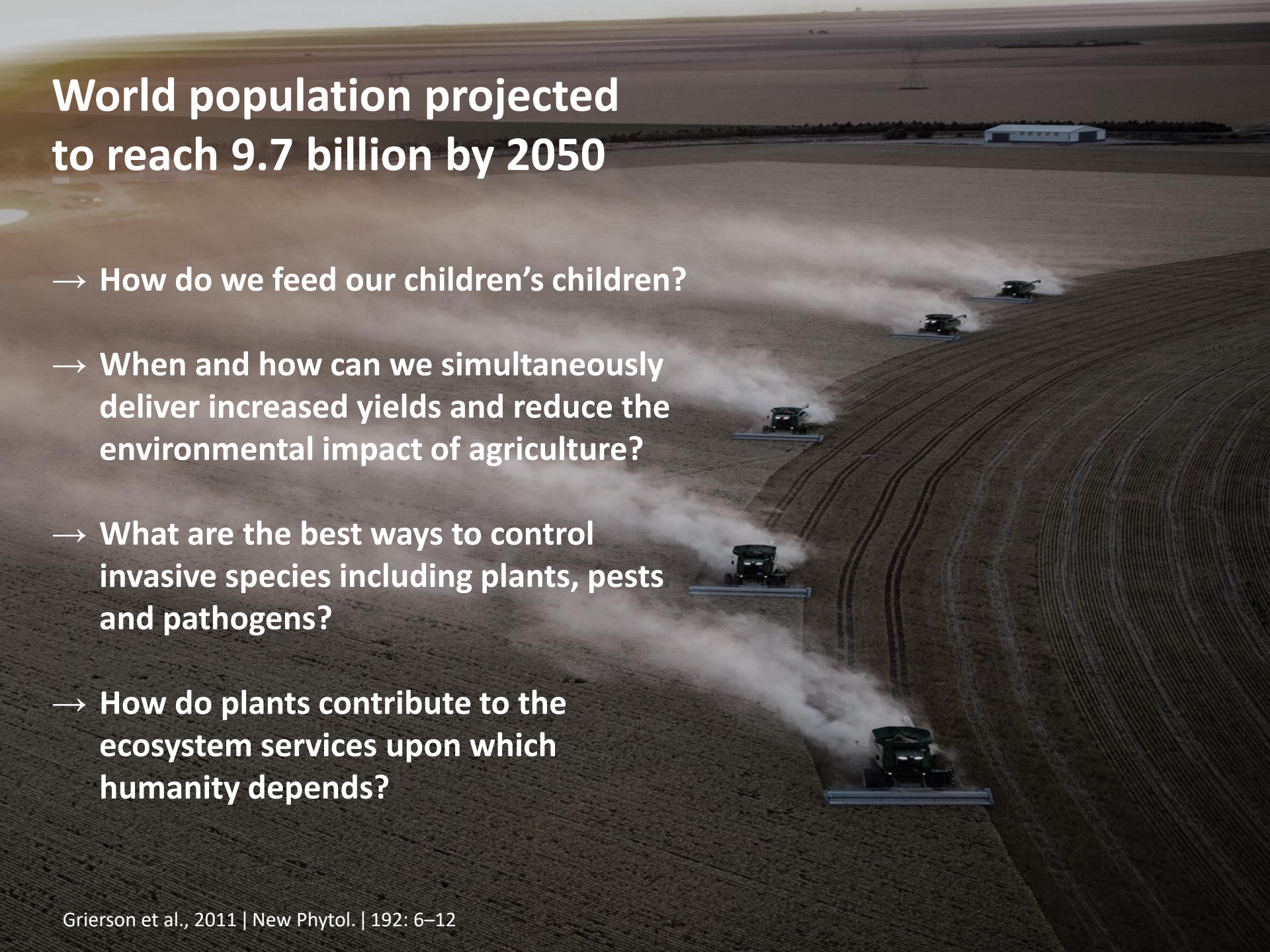
World population projected to reach 9.7 billion by 2050

→ How do we feed our children's children?

→ When and how can we simultaneously deliver increased yields and reduce the environmental impact of agriculture?

→ What are the best ways to control invasive species including plants, pests and pathogens?

→ How do plants contribute to the ecosystem services upon which humanity depends?



Grierson et al., 2011 | New Phytol. | 192: 6–12

International Organization for Standardization

Nanomaterial

'material with any external dimensions in the nanoscale or having internal structure or surface structure in the nanoscale'. The term 'nanoscale' is defined as size range from approximately 1 nm to 100 nm.

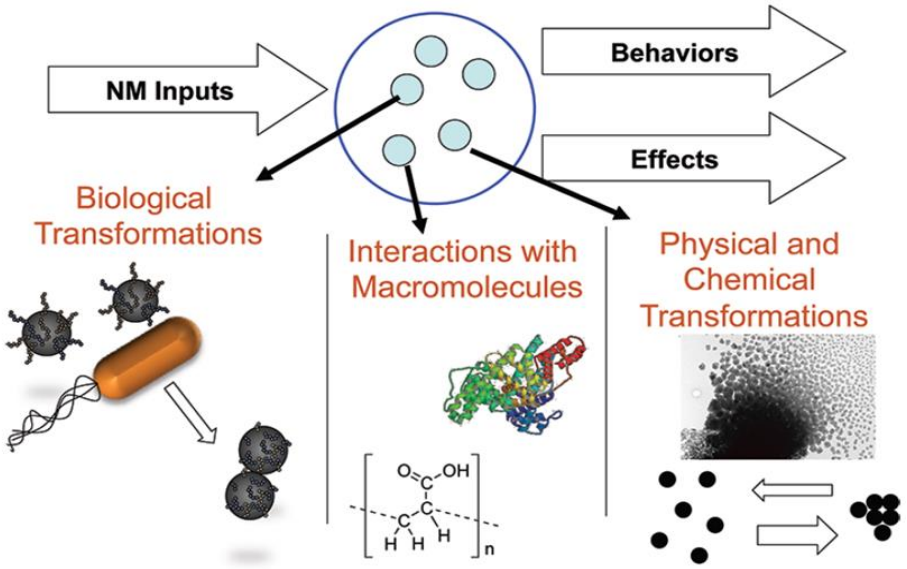

Global
Nanotechnology
Market Outlook 2022
RNCOS


Global Nano Technology Market Size USD (Billion)
25
20
15
10
5
0
2017
2018
2019
2020
2021
2022
2023
2024
2025
Market Size USD (Billion)

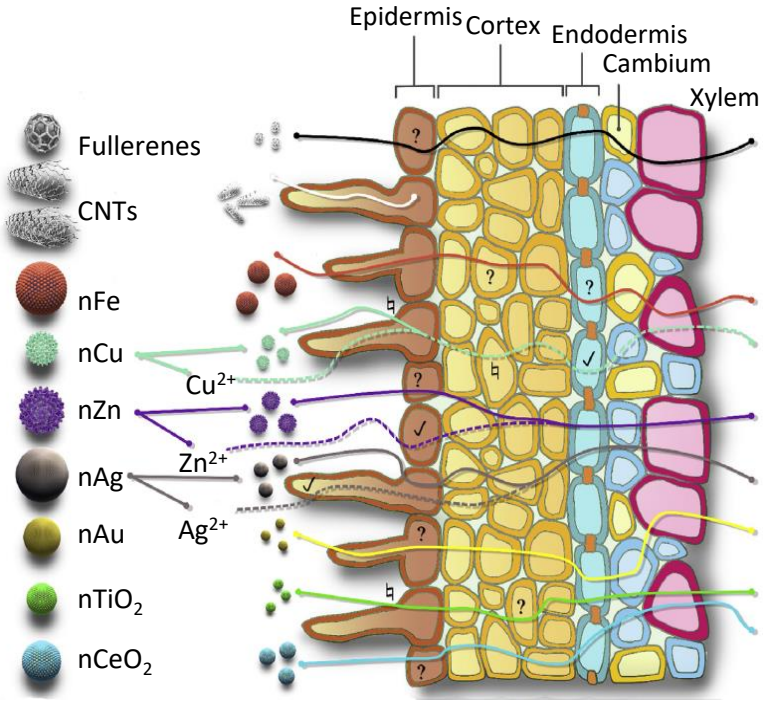

Nanotechnology is the
FUTURE!

Nanotechnology is recognized by the European Commission as one of its six ‘‘Key Enabling Technologies’’ that contribute to sustainable competitiveness and growth in several fields of industrial application.

ENMs in the environment



ENMs vs plants



Pathway from nanotechnology to agro-ecosystem

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

doi: 10.1021/jf104517j | J. Agric. Food Chem. 2011, 59, 3485–3498 REVIEW

pubs.acs.org/JAFC

Interaction of Nanoparticles with Edible Plants and Their Possible Implications in the Food Chain

Cyren M. Rico, Sanghamitra Majumdar, Maria Duarte-Gardea, Jose R. Peralta-Videa and Jorge L: Gardea-Torresdey

ELSEVIER

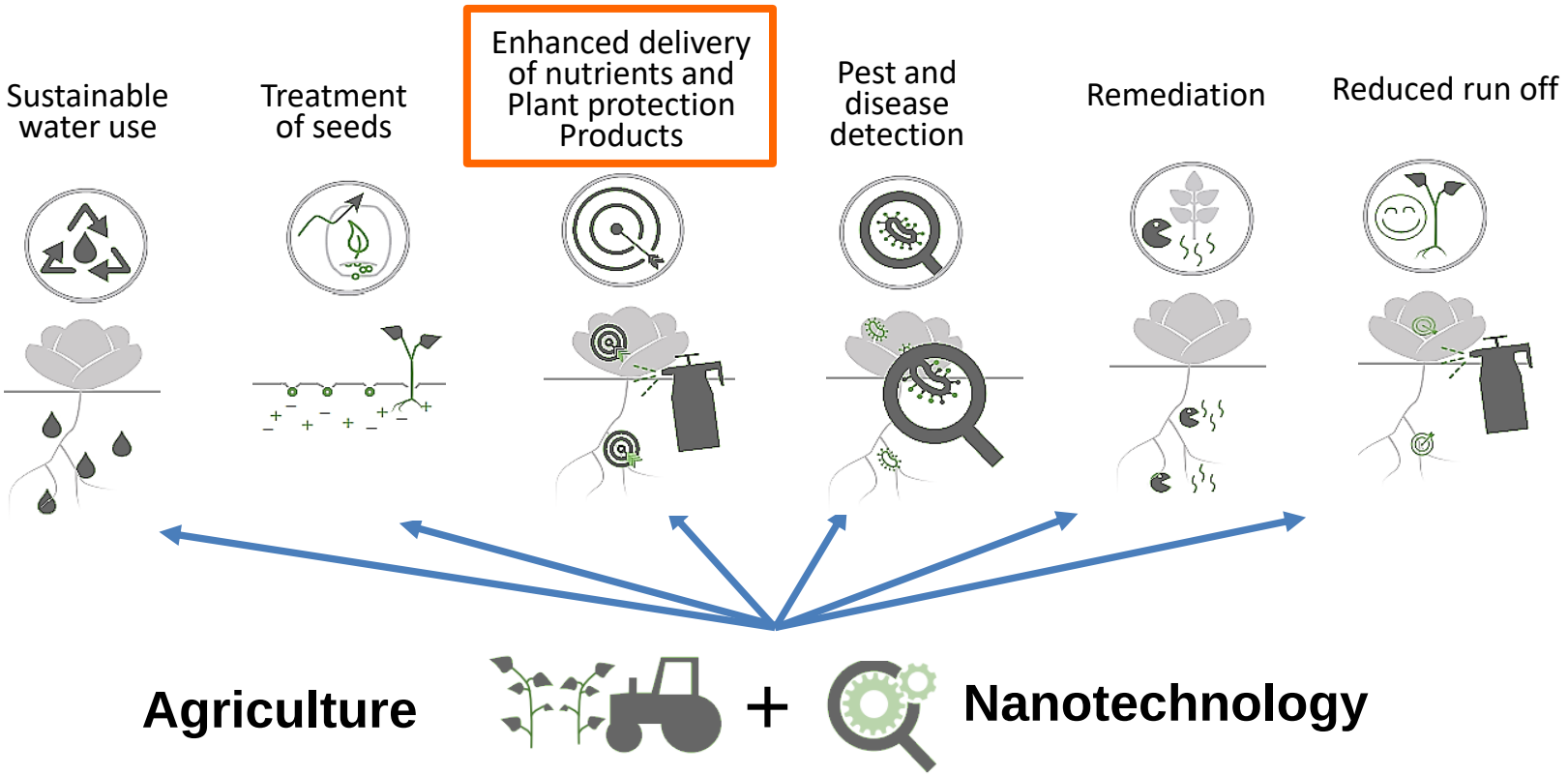
Food Research International 69 (2015) 381-400

Review

Nanotechnology in agro-food: from field to plate

Nandita Dasgupta, Shivendu Ranjan, Deepa Mundekkad, Chidambaram Ramalingam, Rishi Shanker, Ashutosh Kumar

Fourth Agricultural Revolution 2020 -2040?

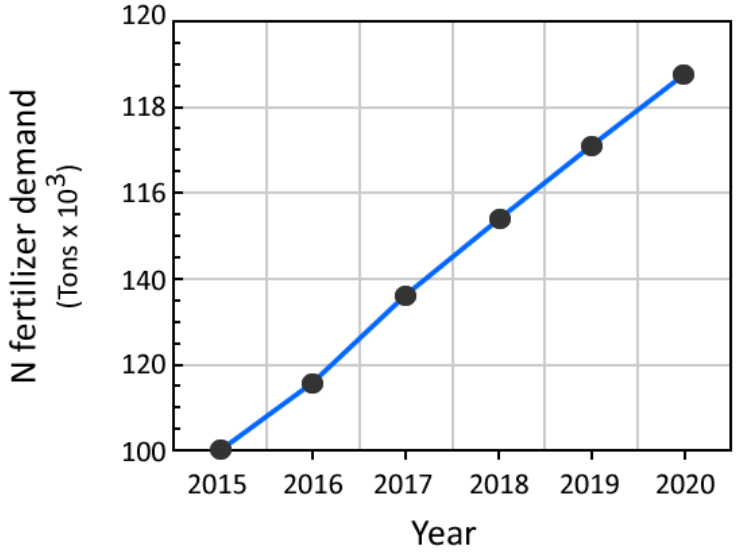


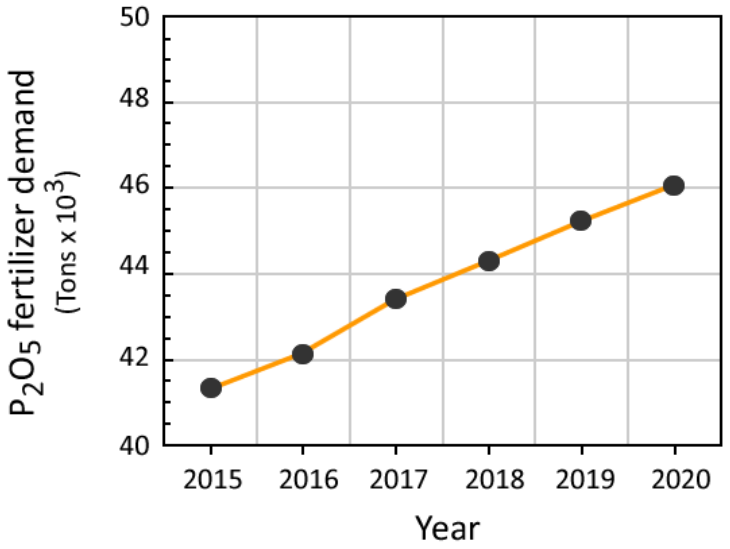
Nutrient Use Efficiency

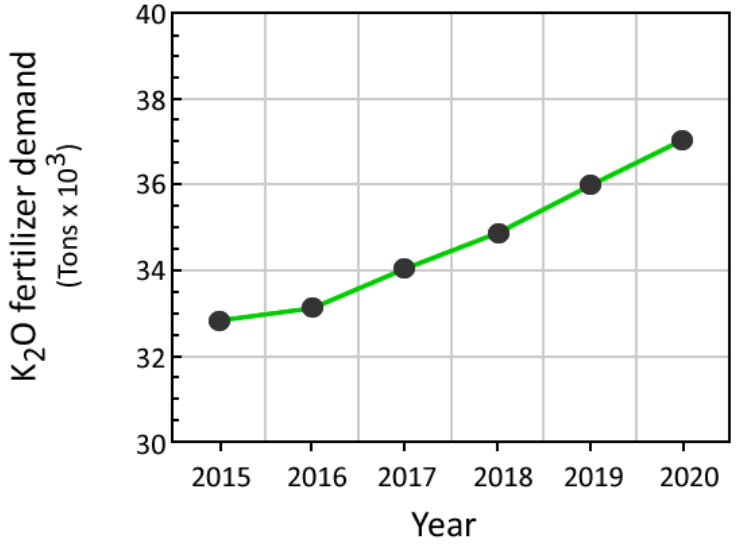
Maximum economic yield or dry matter produced per unit of any nutrient that is applied or unit of that particular nutrient taken up.

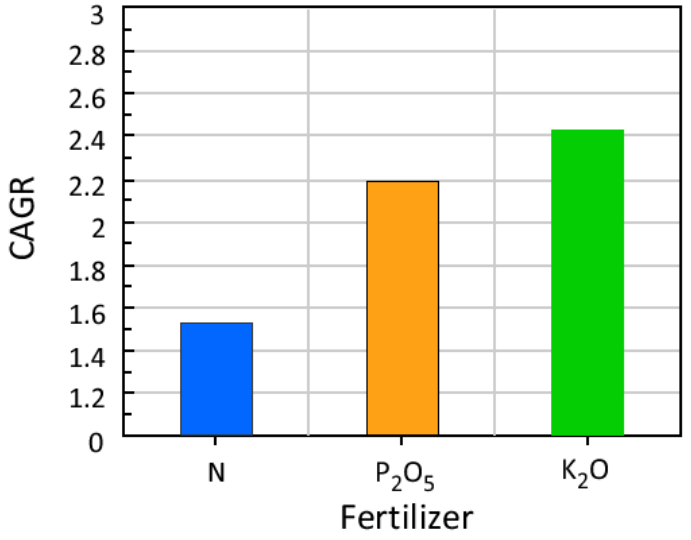
Factors That Influence the NUE

→ Plant Factors
→ Soil Factors
→ Fertilizer Factors
→ Agronomic/Management
→ Abiotic Stresses
→ Biotic Stresses









FAO 2016. World fertilizer trends and outlook to 2020

NUE traditional fertilizers very low

Losses

40–70 % N

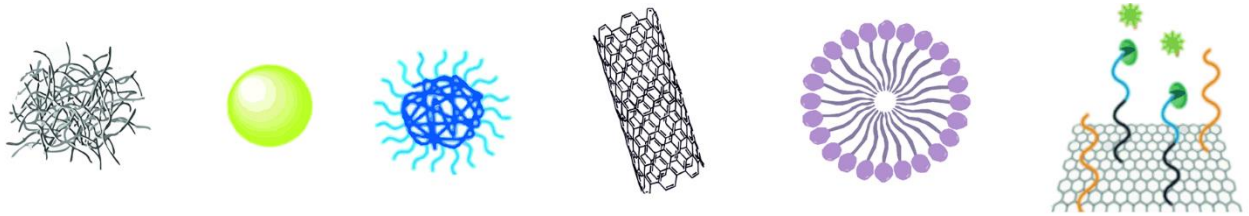
80–90 % P

50–90 % K

Kumar Mani P. and Mondal S. 2016. in: Plant Nanotechnology. Kole et al. (eds.)
Springer International Publishing, pp 263-303.

Types of nanofertilizers

- → Macro/micronutrient encapsulated by NMs
- → Macro/micronutrient at nanoscale level
- → NM-enhanced fertilizer
- → Engineered NMs (TiO_2-NPs, CNTs, Graphene)

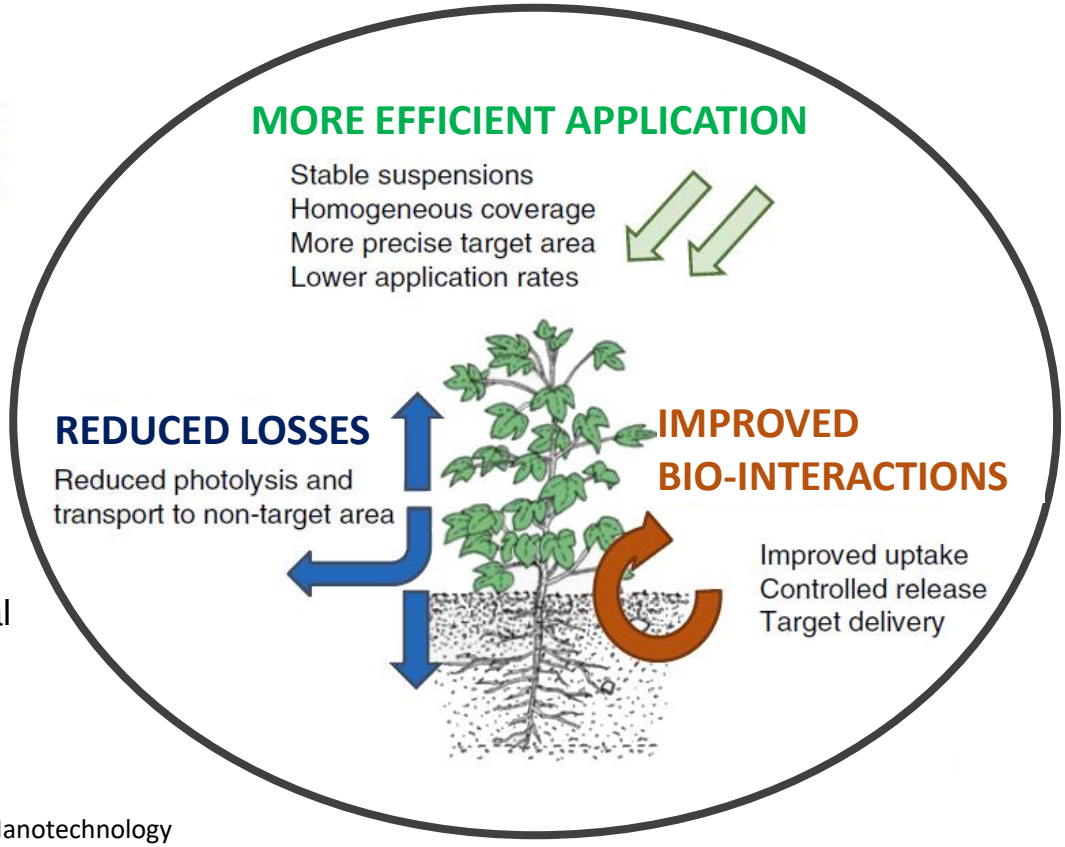


Raliya et al. 2018. J Agric Food Chem

Key drivers to improve efficacy of nanofertilizers

Social acceptance?

Environmental footprint



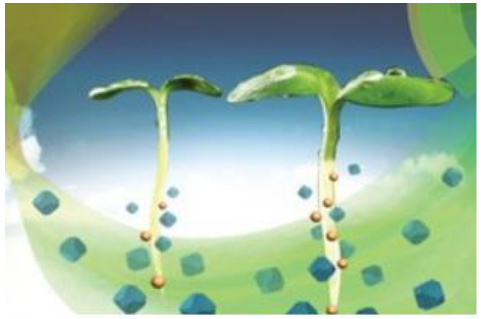
Scalability?

Economic viability?

Kah et al. 2018. Nature Nanotechnology

quiuniud

HOME | VITA D'ATENEO | RICERCA E INNOVAZIONE



21 SETTEMBRE 2017

L'Università di Udine partecipa a NanoInnovation 2017

Luca Marchiol, del dipartimento di Scienze agroalimentari, ambientali e animali, parlerà di fitonanotecnologie

7 SETTEMBRE 2018

Nanotecnologie in agricoltura: l'Università di Udine a NanoInnovation 2018

Luca Marchiol del Di4a presenterà gli sviluppi della ricerca nell'ambito delle nanotecnologie applicate al settore primario

Nano 2019 Innovation

Rome, 11-14 June

Conference & Exhibition

12/06/2019 Workshop AgriNanoTechniques: Nanomaterials for products and application in agriculture

DI4A – Facilities and collaborations

→ sp-ICP-MS Perkin Elmer
→ ICP-OES (Varian Vista Pro)
→ TEM PHILIPS CM 10
→ ESEM FEI 200
→ Microscopio a fluorescenza (Zeiss)
→ NMR Bruckner 400
→ Spettrofotometro (Agilent)
→ Spettrofluorimetro (Perkin Elmer)
→ HPLC (Agilent)
→ Ultracentrifughe (Beckman)

- Marta Marmiroli et al. – Univ. Parma;
- Cristina Gonnelli – Univ. Firenze;
- Elettra Sincrotrone;
- ESRF Grenoble (F);
- CNR ISTEC, Faenza;
- CNR IOM, Area Science Park (TS)
- JRC – ISPRA, Nanobiotechnology Laboratory
- Marco Vittori Antisari – NanoItaly
- Francesco Cubadda – Ist. Sup. Sanità, Roma
- Iseult Lynch – Univ. Birmingham (UK);
- Damjana Drobne – Univ. Lubljana (SLO)

Attività di ricerca

ENMs → Seed germination stage

- Germination %
- Seed vigor
- Germination Time

Seed germination stage → Hydroponic/Pot culture

Hydroponic/Pot culture →

- Phenology/Morphology
- Growth cycle
- Stomatal behavior
- Photosynthesis
- Nutrient uptake
- Sugar transport
- Secondary metabolism
- ROS pathway
- Influence on defence mechanisms
- Ultrastructural analysis

Lab testing

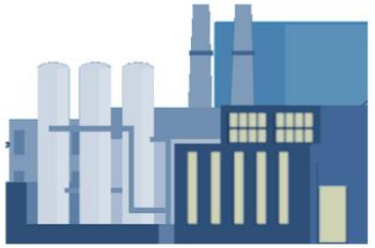
Greenhouse/Field trials

ENMs →

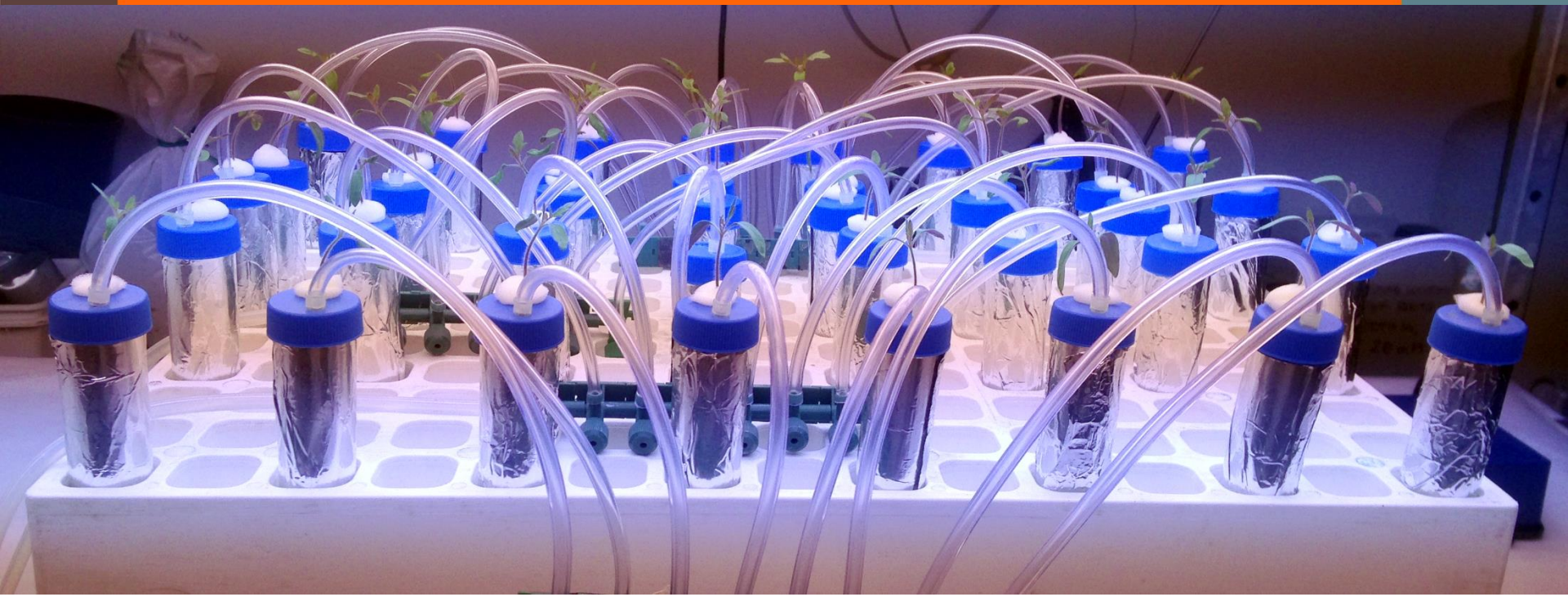
→

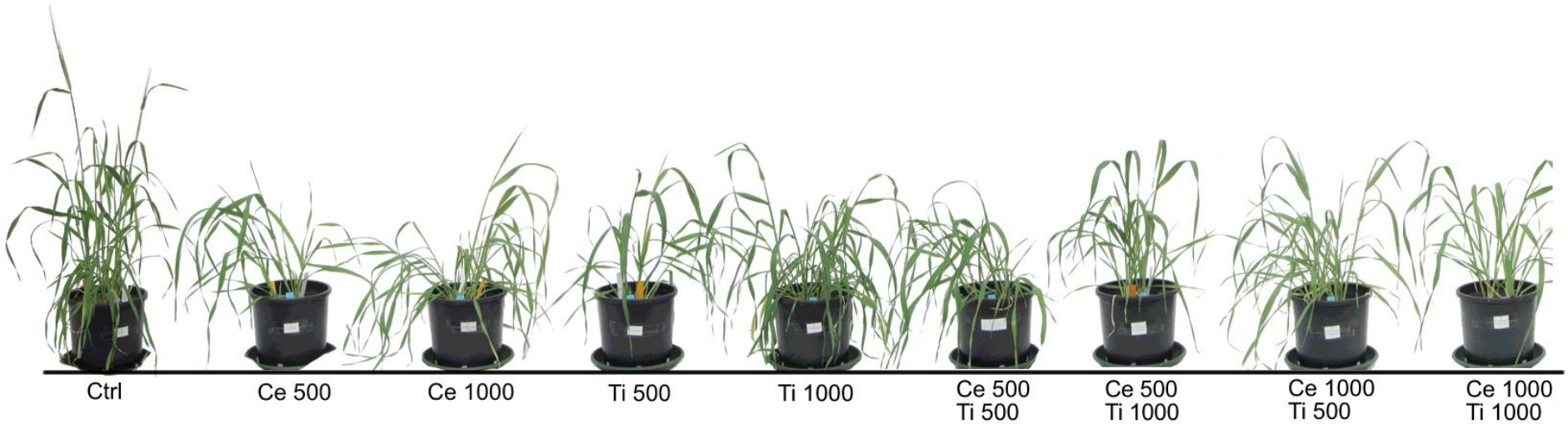
- Growth parameters
- Yield components
- Yield quality
- ENMs management (application mode, residues, leaching)

→



→ MARKET




Ctrl
Ce 500
Ce 1000
Ti 500
Ti 1000
Ce 500
Ti 500
Ce 500
Ti 1000
Ce 1000
Ti 500
Ce 1000
Ti 1000

agronomy

MDPI

Article

Influence of Hydroxyapatite Nanoparticles on Germination and Plant Metabolism of Tomato (*Solanum lycopersicum* L.): Preliminary Evidence

Luca Marchiol [1,*], Antonio Filippi [1], Alessio Adamiano [2], Lorenzo Degli Esposti [2,3], Michele Iafisco [2], Alessandro Mattiello [1], Elisa Petrussa [1] and Enrico Braidot [1]

1 Department of Agri-Food, Animal and Environmental Sciences, University of Udine, via delle Scienze 206, 33100 Udine, Italy; antoniofilippi@yahoo.it (A.F.); alessandro.mattiello@uniud.it (A.M.); elisa.petrussa@uniud.it (E.P.); enrico.braidot@uniud.it (E.B.)

2 Institute of Science and Technology for Ceramics (ISTEC), National Research Council (CNR), Via Granarolo 64, 48018 Faenza (RA), Italy; alessio.adamiano@istec.cnr.it (A.A.); lorenzo.degliesposti@istec.cnr.it (L.D.E.); michele.iafisco@istec.cnr.it (M.I.)

3 Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Parco Area delle Scienze 17/a, 43124 Parma, Italy

* Correspondence: luca.marchiol@uniud.it; Tel.: +39-432-558611

Received: 28 February 2019; Accepted: 23 March 2019; Published: 27 March 2019

Obiettivi dell'attività di ricerca del dottorato multi impresa

- Interazioni nanomateriali-pianta: influenza sul ciclo colturale e variabili produttive;
- Comportamento dei nanomateriali nell'agroecosistema: fato e soglie di tossicità;
- Potenziale dei nanomateriali nella nutrizione delle piante: efficienza e strategie di applicazione.

Vantaggi per le imprese

In generale:

- Aggiornamento semestrale sulle ricerche condotte dal dottorando.
- Appartenenza a un network che coinvolge anche altre imprese.
- Possibilità di prendere contatto con giovani studiosi altamente qualificati.
- Contatto con il mondo accademico che può portare all'azienda ulteriori opportunità future (come ad esempio la partecipazione a progetti congiunti su bandi europei).
- Accedere a benefici fiscali per le erogazioni liberali in favore della ricerca universitaria.
- Ritorno di immagine per aver collaborato con l'Università.

Per la specifica tematica:

- Progetto e sviluppo di nanoformulati fertilizzanti
- Altri nano-carriers
- Brevetti

Contatti

Luca Marchiol
marchiol@uniud.it
0432 558611

Enrico Braidot
enrico.braidot@uniud.it
0432 558792

PUNTO IMPRESA

puntoimpresa@uniud.it
Tel. 0432 556394
www.uniud.it/puntoimpresa

Se la proposta è di interesse, compila il modulo e consegnalo allo staff!