Nutrient Management and Nutrient Recovery Thematic Network

SPREADING KNOWLEDGE

Prof. Massimo Pugliese

University of Torino - Agroinnova

Thursday 16th September 2021

Outline

- NUTRIMAN approach for knowledge transfer to farmers: from EIP-AGRI abstracts to training materials
- Presentation of the 25 selected technologies/products (15 minutes)

Special focus on cases:

- ID192 BioPhosphate and ID1571 Terra Preta biochar (Edward Someus, 3R)
- ID250, ID251, struvite (Francisco Corona Encinas, CARTIF);
- ID208, ID293, struvite (Sofia Grau, DAM);
- ID272 compost, ID264 digestate (Christophe Boogaerts, VLACO).

Q/A discussion 10 minutes.

Nutrient Management and Nutrient Recovery Thematic Network

NUTRIMAN approach for knowledge transfer to farmers: from EIP-AGRI abstracts to training materials

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The NUTRIMAN project

What is NUTRIMAN?

- A **Nitrogen and Phosphorus thematic network compiling and sharing knowledge of "ready-for-practice"** recovered bio-based fertiliser technologies, products, applications and practices for the benefit of agricultural practitioners. **At least sucessfully completed TRL6 maturity level.**
- **Areas of interest:**
- **Nitrogen and Phosphorus nutrient recovery**, novel technologies and innovative fertilizers, food safety and supply security, sustainable food production.

Reasons:

- Ensures that when the new EU Fertilising Products Regulation law harmonization is reaching implementation status in 2022, the agricultural practitioners already know, have tried and are applying such recovered products in practice.

For whom: Farmers, advisors, applied researchers, businesses, NGOs, etc.

Bottom-up approach = the farmers' point of view

The NUTRIMAN project

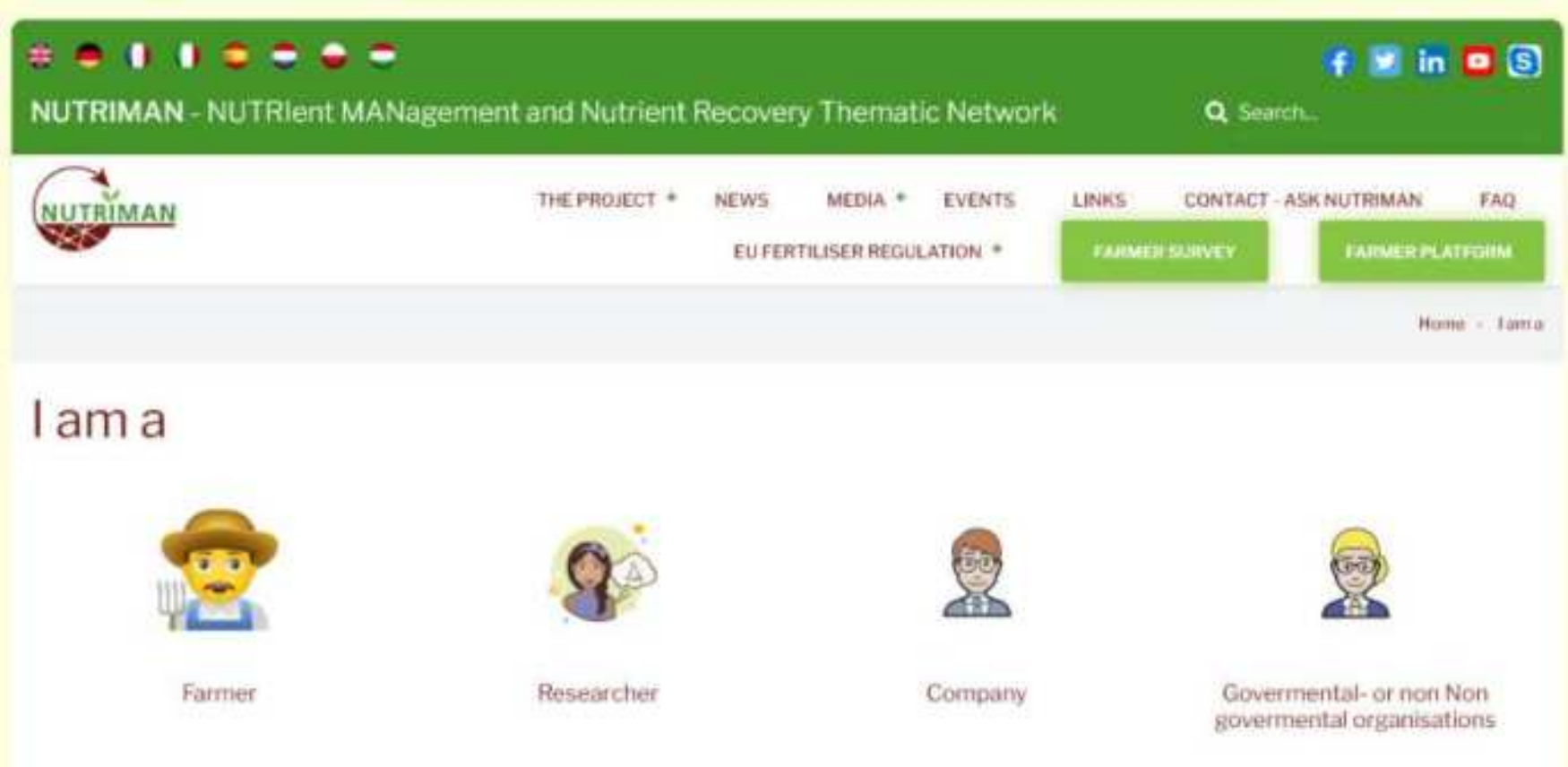
How?

- **Focuses on connecting market competitive and commercially "ready for practice" innovative results** drawn from high research maturity applied scientific programmes and common industrial practices.
- **Brings together innovation actors** (farmers, advisors, researchers, businesses, NGOs, etc.) and helps to build bridges between user-oriented applied research results and agricultural production practices.
- How to connect to NUTRIMAN network: https://nutriman.net/i-am-a

How to connect?

https://nutriman.net/i-am-a

By selecting your end-user page you can easily acess to the **SPECIFIC INFORMATION.**



The NUTRIMAN project – key activities

1. **IDENTIFICATION** of matured innovative research results in the field of N/P recovery EU28 technologies, which are near to be put into practice, but not sufficiently known by agricultural practitioners.
2. **EVALUATION** of innovative N/P nutrient recovery technologies & novel N/P fertiliser products and practices, both by experts and by the potential end-users.
3. **COMPILATION of "ready for practice" knowledge in a form of EIP-AGRI practice abstracts, info sheets, multi-lingual (8 languages) product application and training materials, audio-visual materials and infographics.**
4. **SHARING & SPREADING the collected knowledge towards agricultural practitioners (farmers, farmer organisations, advisory services) during online webinar and face-to-face workshops across Europe.**
5. **LONG TERM OPERATION** (up to year 2031) of 8 languages interactive practice oriented NUTRIMAN farmer platform: https://nutriman.net/farmer-platform

Objective of NUTRIMAN

Technologies and products

For the recovery of N/P

“ready to be put on

the market”

NUTRIMAN

NUTRIMAN Platform
for Farmers
Advice & Recommendations

NUTRIMAN Platform for
Farmers
Practical Knowledge

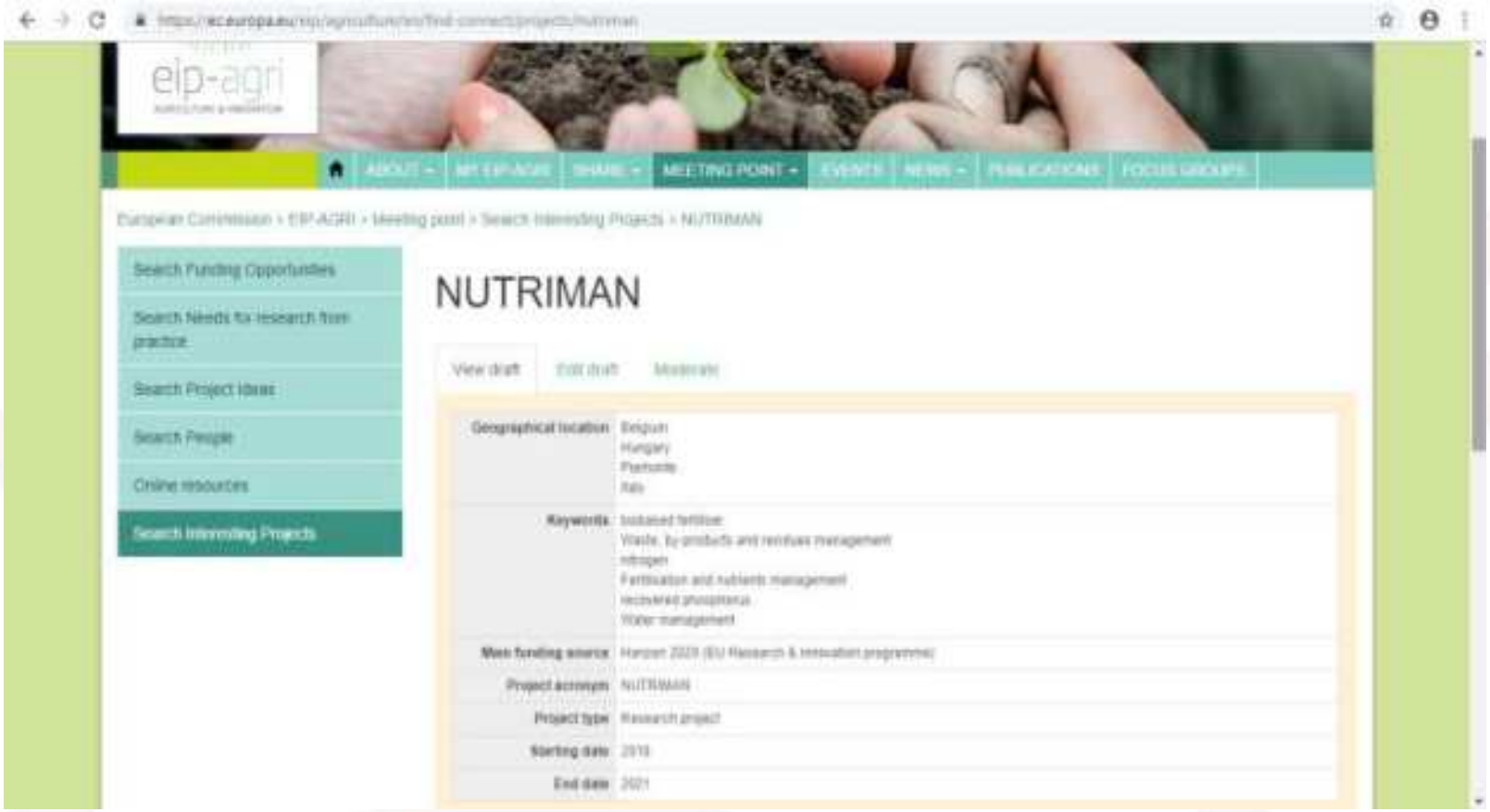
https://nutriman.net/farmer-platform

NUTRIMAN: From EIP-AGRI abstracts to training materials

- Development of 80~100 practice abstracts in the common EIP-AGRI Format
- Translation of selected 25 best practice abstracts into 7 languages + English
- Development of innovative fertilizers application training materials for agricultural practitioners, farmers, farmers organizations and advisory services providers, including fact sheets, instance audio-visual materials (targeting number: 80~100), info sheets and infographics (trageting number: 80~100)

NUTRIMAN webpage on the EIP-AGRI website

https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nutriman%C2%A0-nutrient-management-and-nutrient



NUTRIMAN delivered 96 practice abstracts, 102 audiovisual materials and more.

EIP-AGRI practice abstracts features and content

Three different kind of EIP-AGRI practice abstracts:

- EIP-AGRI practice abstract on N&P recovered fertilizer **products**
- EIP-AGRI practice abstract on N&P recovering **technologies**

Tot. 82 P&T practice abstracts

- **Thematic** EIP-AGRI practice abstract on the use of fertilizers' categories in certain areas of Europe

Fertilizers' categories for thematic EIP-AGRI practice abstracts → **Tot. 14 thematic practice abstracts**

1.Compost and digestate (and biomass)

1.1 Compost (Southern & Northern Europe) → 2 thematic practice abstracts
1.2 Digestate (Southern & Northern Europe) → 2 thematic practice abstracts
1.3 Alternative biomass → 1 thematic practice abstracts

2. Ash → 1 thematic practice abstracts

3. Struvite and other P-product

3.1 Struvite → 1 thematic practice abstracts
3.2 Precipitated calcium phosphate → 1 thematic practice abstracts

4. Biochar and bio-phosphate → 1 thematic practice abstracts

4.1 Biochar
4.2 BioPhosphate

5. Scrubber water and mineral nitrogen concentrates

5.1 Scrubber water → 1 thematic practice abstracts
5.2 Ammonium nitrate/sulfate → 1 thematic practice abstracts
5.3 Mineral concentrate → 1 thematic practice abstracts
5.4 Solid manure → 1 thematic practice abstracts
5.5 Liquid manure → 1 thematic practice abstracts

Tot. 96 EIP-AGRI practice abstracts

Example of EIP-AGRI practice abstract on product

Title: Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)

Florawiva is a multi-nutrient and a high carbon soil improver with a loose structure. The composting process utilizes de-hydrated effluents from the anaerobic digestion of organic fraction of municipal solid waste, of green residues from separate urban collection and dehydrated effluents from the wastewater treatment plant. The compost improves soil fertility and releases its nutrients slowly, reducing risks of leaching. Florawiva also improves soil biodiversity by increasing microbiological flora, increases cation exchange capacity of soil and water retention capacity, the contribution of organic matter maintains the fertility of the soil and reduces the phenomenon of desertification. Florawiva has a basic pH (8.3). Nutrient content N-P-K: 2.4% N (d.m.), 2.3% P_2O_5 (d.m.), 1.3% K (d.m.) and other macro-elements (CaO, MgO). Acea Pinerolese's compost is sold bulk to the public around 21€/t. The price varies according to the volumes of the quantities requested. It is also offered in 1 m^3 big bag formulation and 40 liter bags (about 22Kg). Florawiva S is also available: a substrate consisting of a mixture of compost+peat+perlite. Florawiva can be used in open field for cereals, replanting of orchards, tree crops, floriculture and horticultural crops, for the reconstitution of meadows and also in greenhouses. The recommended doses are variable depending on the quality of the soil, the season, the type of crop in place and the expected productivity. Acea technicians will be able to provide the relevant information. In the open field the doses are on average variable from 10 to 30 t/ha.

For more information: https://nutriman.net/farmer-platform/product/id_210

Direct link to EIP-AGRI practice abstract ID:210

Example of EIP-AGRI practice abstract on technology

Title: Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)

ACEA PINEROLESE takes care of treating municipal organic wastes for the production of biogas and digestate (sludge quite stabilized and hygienized). The company serves a user basin of about 1 million of inhabitants for the treatment of organic waste. The current capacity is 60,000 t/y of organic waste. The first phase of the process consists of an anaerobic biodigestion (in the absence of oxygen), which allows the recovery of material (compost) with an innovative energy recovery system (biogas). In the future framework, all the biogas is going to be used for biomethane production. Digested organic waste (digestate) is dehydrated and then sent to the composting system, integrated to the facility. The biogas obtained from fermentation is conveyed to a gasometer and temporarily stored. The water used in the process is partly recirculated, while the remaining portion is sent to the wastewater treatment plant, integrated to the facility. The process produces biogas, a natural gas rich in methane. The biogas coming from the plants of the Integrated Environmental District of ACEA, together with the biogas from the landfill and the biogas from the wastewater treatment plant, is stored in a gasometer. The mixture of biogas is sucked from the gas-holder, cooled and sent to 3 Otto cycle engines (the total nominal power is 3 MW). The electricity and the heat produced are used for internal consumption and the excess is transferred to the electric grid and to the district heating, respectively. The enhancement system of biogas for energy purposes developed by ACEA prevents the dispersion of biogas into the atmosphere. Compost is another final product (end-of-waste).

For more information: https://nutriman.net/farmer-platform/technology/id_209

Direct link to EIP-AGRI practice abstract ID:209

Example of Thematic EIP-AGRI practice abstract

Title: The use of compost in Southern Europe.

Compost is a humus-like material derived from organic waste composting as a result of the action of aerobic bacteria, fungi, and other organisms. Input material: organic wastes, including organic fraction of municipal solid waste, green residue from separate urban collection, dehydrated effluent from wastewater treatment plant, food wastes, green wastes, farms' manures, straw and algae. Compost provides a good amount of organic matter, and the slower release of nutrients has positive effects on plants development, demonstrating to be able to substitute, at least partially, mineral fertilizers. Some composts (ID:210-260-540) a reusable in organic farming. They are odorless products thanks to temperature monitoring and maturation time. These products are well-stabilized but able to increase soil fertility. They have a good effect on acidic soils. Furthermore, ID 210 is produced from pre-digested selectively collected organic waste streams, and the integrated anaerobic digestion process allows producing also biomethane. The main bottleneck for the application of compost in Southern Europe is when you have to apply the product in an area sensitive to nitrogen or phosphorus, according to the local regulation from directives 2000/60/CE and 91/676/CEE. Consequently, the application dosage must be chosen according to soil availability and crop uptakes. Finally, for correct spreading, it is necessary to use a manure spreader equipped with reinforced chains.

For more information:

- https://nutriman.net/farmer-platform/product/id_210 (Italy)
- https://nutriman.net/farmer-platform/product/id_260 (Italy)
- https://nutriman.net/farmer-platform/product/id_540 (France)

Direct link to thematic EIP-AGRI practice abstract on the use of compost in Southern Europe

Availability of EIP-AGRI PRACTICE ABSTRACTS IN 8 LANGUAGES

Title: Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)

ID 210: Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process.....31

Kompost aus Grünabfällen und aufgeschlossenen Mischabfällen nach dem Verfahren „ACEA Pinerolese".

Compost de déchets verts et déchets mixtes issus du procédé « ACEA Pinerolese ».

Compost prodotto da rifiuti verdi e da digestato di rifiuti organici mediante il processo "ACEA Pinerolese".

Compost procedente de restos vegetales y digestato de residuos obtenidos mediante el proceso "ACEA Pinerolese".

Compost van groenafval en vergist gemengd afval via het "ACEA Pinerolese" proces.

Kompost z odpadów zielonych i przefermentowanych odpadów mieszanych uzyskany w procesie „ACEA Pinerolese".

Zöld hulladékból és fermentált vegyes hulladékból „ACEA Pinerolese" eljárással előállított komposzt.

Direct link to the BOOKLET

Training materials features and content

Three different groups of training materials

Development of innovative fertilizers application **training materials** (Published: 97) for agricultural practitioners, farmers, farmers organizations and advisory services providers, including **fact sheets**, instance **audio-visual materials** (targeting number: 80~100 → Published: 102), **info sheets** and **infographics** (trageting number: 80~100 → Published: 164)

- Training materials on N&P recovered fertilizer **products**
- Training materials on N&P recovering **technologies**
- **Thematic training materials** on the use of fertilizers' categories in certain areas of Europe

Fertilizers' categories for thematic EIP-AGRI practice abstracts → **Tot. 15 thematic training materials**

1.Compost and digestate (and biomass)
- 1.1 Compost (Southern & Northern Europe) → 2 thematic practice abstracts
- 1.2 Digestate (Southern & Northern Europe) → 2 thematic practice abstracts
- 1.3 Alternative biomass → 1 thematic practice abstracts

2. Ash → 1 thematic practice abstracts

3. Struvite and other P-product
- 3.1 Struvite → 1 thematic practice abstracts
- 3.2 Precipitated calcium phosphate → 1 thematic practice abstracts

4. Biochar and bio-phosphate
- 4.1 Biochar → 1 thematic practice abstracts
- 4.2 BioPhosphate → 1 thematic practice abstracts

5. Scrubber water and mineral nitrogen concentrates
- 5.1 Scrubber water → 1 thematic practice abstracts
- 5.2 Ammonium nitrate/sulfate → 1 thematic practice abstracts
- 5.3 Mineral concentrate → 1 thematic practice abstracts
- 5.4 Solid manure → 1 thematic practice abstracts
- 5.5 Liquid manure → 1 thematic practice abstracts

Tot. 97 training materials

Example of Training materials on product

Title: Compost from green waste and digested mixed-waste bv "ACEA Pinerolese" process (ID:210)

[TRAINING MATERIAL ID:210]

[INFO SHEET ID:210]

[INFOGRAPHIC ID:210]

[VIDEO ID:210]

https://nutriman.net/farmer-platform/product/id_210

Example of Training materials on technology

Title: echnology for N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)

TRAINING MATERIAL ID:209

INFO SHEET ID:209

INFOGRAPHIC ID:209

VIDEO ID:209

Example of Thematic training material

Title: The use of compost in Southern Europe.

Main features of the subcategory

Composts significantly increase soil organic matter (SOM) contents, a key soil quality indicator that is on the contrary declining in many regions of the world. There are many compounds within compost that influence the biological process in soil, improving the physical and chemical characteristics. Humates improve the soil structure and then the plant roots could easier penetrate. Improving root growth, the stability of trees increases and the water stress decreases. Additional benefits of compost addition to soil are promoting soil biological activity, reducing erosion losses, decreasing bulk density, improving structural stability, nutrient availability and plant uptake, increasing the water holding capacity. The use of compost is also interesting as a peat substitute, in particular after recent increasing concern on peat extraction and the damage of peat lands natural habitats by the horticulture industry that lead to the adoption of alternative substrates. However, composts can hardly be used alone as a growing media; it is necessary to do a germination test or compost analysis to determine the suitability because will be often kill or damage plants due to excessive salinity.

Input material

Organic wastes, including organic fraction of municipal solid waste, green residue from separate urban collection, dehydrated effluent from wastewater treatment plant, food wastes, s green wastes, farms' manures, straw and algae.

How to produce?

Composting is the decomposition process of organic waste by the action of aerobic bacteria, fungi, and other organisms. To obtain a good composting process, it is necessary to have a good ratio of carbon-rich input materials and N-rich input materials. Also the temperature, CO_2 and moisture content are important parameters. To aerate and homogenise the pile it is necessary to turn it over from time to time. At farm level this can be done with a windrow turner. The follow-up and turning of the pile requires extra time and labour for the farmer. Farm-level composting could be used for optimisation of the quality of the solid fraction of manure as fertilizer/soil improver, and reduce nutrient losses during storage. Composting (self-heating) of the product at temperatures exceeding 70°C is only possible if a maximum of 30 wt% of solid fraction of pig manure is used. This can then be combined with the solid fraction of cattle slurry, cattle manure with straw, horse manure or poultry manure to obtain enough structure and an optimal C/N ratio. Some sites also add vegetal biomass or vegetable, fruit and garden (VFG) waste or green waste compost. This mostly occurs in a closed shed consisting of several tunnels which can be closed off and aerated separately (large capacity). It can also be done by use of an aerated drum (feasible at farm scale level). The material can also be placed in rows on the floor and is turned over manually (extensive composting).

Typical nutrient content and availability for plants

The compost usually contains 0.8-2.4% N (d.m.), 0.7-2.3% P_2O_5 (d.m.), 1.3-1.8% K_2O (d.m.) with a 40% of humidity.

Examples for compost products available on the NUTRIMAN Farmer Platform

- https://nutriman.net/farmer-platform/product/id_210 (Italy)
- https://nutriman.net/farmer-platform/product/id_260 (Italy)
- https://nutriman.net/farmer-platform/product/id_540 (France)

Some composts selected in the NUTRIMAN project are available in Southern Europe.

The compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210 – Figure 1) is made starting from de-hydrated effluent from the anaerobic digestion of organic fraction of municipal solid waste, green residues from separate urban collection and dehydrated effluent from the wastewater treatment plant. It contains 2.4% N (d.m.), 2.3% P_2O_5 (d.m.), 1.3% K_2O (d.m.) with a 40% of humidity.

The compost from green and food wastes by "Biociclo" process (ID:260 – Figure 2) is made starting from biowaste, food waste collected door to door and green waste; and it contains about 2.4% N (d.m.), 1.2% P_2O_5 (d.m.).

In France the compost from algae and cattle manure by local composting process is available (ID:540 – Figure 3). It is made starting from cattle manure, equine manure, straw and algae and contains 0.8% N (d.m.), 0.71% P_2O_5 (d.m.), 1.82 K_2O (d.m.).

Figure 1. ACEA compost (ID:210).

Figure 2. BIOCICLO compost (ID:260).

Figure 3. French compost (ID:540).

Fields of application in agriculture: crop, dosages, application method and practical recommendations.

The composts (ID:210-260-540) are used at 5-30 t/ha according to soil quality, season and crop uptake. They could be used to improve the production of a lot of cereal and horticulture crops, such as potato, wheat, corn, soybean, sunflowers, cabbage, pumpkin, cucumber, tomato, leafy vegetables, celery, leek, and also used in floriculture, horticulture and vineyard.

Example of Thematic training material

Title: The use of compost in Southern Europe.

Benefits for farmers

Compost provides a good amount of organic matter and the slower release of nutrients had positive effects on plants development, demonstrating demonstrated to be able to substitute, at least partially, mineral fertilizers.

The composts (ID:210-260-540) are all usable in organic farming. They are odorless product thanks to temperature monitoring and maturation time.

Composts have a low C/N ratio: the products are well-stabilized but able to increase soil fertility.

They have a good effect on acidic soils.

Composts are closing material and nutrient cycle: secure source of carbon, nitrogen, phosphor, and other macro-/microelements.

Composts contribute to improve soil biodiversity by increasing microbiological fauna & flora Increases soil fertility.

They are characterized by a low release of nutrients and increase cation exchange capacity of soil.

Moreover, composts reduce leaching and increase water retention capacity and thereby decrease vulnerability to erosion and desiccation (droughts).

Furthermore, ID 210 is produced from pre-digested selectively collected organic waste streams,and the integrated anaerobic digestion process allows producing biomethane.

Bottlenecks of application. Potential risk or limitation.

The main bottleneck for the application of compost is when you have to apply the product in an area sensitive to nitrogen or phosphorus, according to the local regulation from directives 2000/60/CE and 91/676/CEE. Consequently the application dosage must be chosen according to soil availability and crop uptakes.

Finally, for correct spreading, remember that it is necessary to use a manure spreader equipped with reinforced chains. In fact, given the finer texture of the product compared to manure, it is possible that using a common manure spreader the product slips under the chains, generating a pressure that breaks them.

Legal framework for using

Specific national legal conditions

ID:540 respect the French standard NF U44-051.

ID:210 is registered to "Registro Fabbricanti" n° 00218/07 for the fertilizer market, and it is authorized to sell 5 conventional products ("Registro uso convenzionale") and one biological product ("Registro uso biologico"), according to the Italianlegislation (D.Lgs. 75/2010).

ID:260 holds a "Quality certificate" assigned by CIC (Consorzio Italiano Compostatori), according to the Italian legislation (D.Lgs. 75/2010).

EU Fertilising Products Regulation

ID:210 is a PFC 3 A 'Organic Soil Improver". Furthermore it is eligible to be categorised as Component Material Category (CMC) 3 'Compost'

ID:260 is a PFC 3 A 'Organic Soil Improver', which can also re-enter into PCF 4 as 'Growing medium". Furthermore it is eligible to be categorised as Component Material Category (CMC) 3 'Compost'

ID:540 is a PFC 3(A) : organic soil improver.

All these products (ID:210-260-540) are applicable in organic farming.

Economic evaluation of the application of the products

Usually compost (ID:210-260-540) costs about 2-20€/t ex works depending on required volume and packaging. Considering improved yields and quality, these costs are generally sustainable (about 50-200€/ha).

Unlike other fertilizer, which could be easier transported and distributed because of their lower water content, composts are more feasible when applied nearest to the manufacturers' plants because high quantities (5-30t/ha) are applied.

Best management practice guideline, taking into account of specific conditions of the given territory, for the use of the product to the specific applications (soil improvers, growing media, organic fertilisers etc.).

Application doses

- Soil improvers:
  - ID:210 → from 10 to 30 t/ha (according to soil quality, season, crop uptake,...)
  - ID:260 → from 20 to 35 t/ha (according to soil quality, season, crop uptake,...)
  - ID:540 → from 10 t/ha up to 25 t/ha (according to soil quality, season, crop uptake,...)
- Growing media:
  - ID:210 → 5-20% (v/v) mixed to other components; 0% on acid loving plants.
  - ID:260 → 5-20% (v/v) mixed to other components; 0% on acid loving plants.
  - ID:540 → 5-20% (v/v) mixed to other components; 0% on acid loving plants.
- Organic fertilizers:
  - ID:210 → from 10 to 30 t/ha (according to soil quality, season, crop uptake,...)
  - ID:260 → from 20 to 35 t/ha (according to soil quality, season, crop uptake,...)
  - ID:540 → from 10 t/ha up to 25 t/ha (according to soil quality, season, crop uptake,...)

Example of Thematic training material

Title: The use of compost in Southern Europe.

How to store, apply to land, machinery needs.

Composts should be stored in dry place and not directly exposed to the sunlight. Particularly if the compost is not packaged one of the simplest methods of compost storage is on the ground covered with a tarp or plastic sheet. This will prevent excess moisture from rain and snow runoff, but will allow some moisture to seep through and keep the mound moist. Remember that composts have a higher content of water (about 40%) compared to mineral fertilizers, which increases transport costs, makes it necessary to distribute high dosages per hectare and difficult to spread. In fact it could get stuck under the chains of the manure spreader risking breaking them. It is necessary to be very careful when spreading.

For more information:

- https://nutriman.net/farmer-platform/product/id_210 (Italy)
- https://nutriman.net/farmer-platform/product/id_260 (Italy)
- https://nutriman.net/farmer-platform/product/id_540 (France)

Direct link to thematic training material on the use of compost in Southern Europe

Conclusions

“Ready for practice” knowledge (in 8 languages):

- 96 EIP-AGRI practice abstracts,
- 97 training materials,
- 102 audio-visual materials,
- 82 info sheets,
- 82 infographics.

Available for agricultural practitioners, farmers, farmers organizations and advisory services providers:

www.nutriman.net/farmer-platform

Nutrient Management and Nutrient Recovery Thematic Network

Presentation of the 25 selected technologies and products

Prof. Massimo Pugliese

University of Torino - Agroinnova

Thursday 16th September 2021

The best 25 NUTRIMAN N&P recovery products and technologies in agriculture

Results of the selection:

Product (17)	**Technology (8)**
Biochar and Bio-Phosphate (192-1571)	Thermochemical nutrient recovery
Ash (401)	P precipitation from liquid manure, waste water and drain water
Struvite and other P-precipitates (251-293)	Physic-chemical nitrogen recovery from manure, digestate and wastewaters: separation, stripping and membrane processes (273-296-455-668)
Compost and Digestate (incl. derivatives) (210-260-264-270-272-280)	Biological nutrient recovery: composting, anaerobic digestion (209-261-271-292)
Scrubber waters & mineral nitrogen concentrates (266-281-295-454-596-667)	

Presentation of the best NUTRIMAN N&P recovery products and in agriculture

Results of the selection:

Products (17)
CATEGORY: Biochar and Bio-Phosphate Subcategory: Bio-Phosphate → P1 ID:192 Subcategory: Biochar → P2 ID:1571
CATEGORY: Ash Subcategory: Ash → P3 ID:401
CATEGORY: Struvite and other P-precipitates Subcategory: Struvite → P4 ID:251; P5 ID:293.
CATEGORY: Compost and Digestate (incl. derivatives) Subcategory: Compost → P6 ID:210, P7 ID:260, P8 ID:272, P9 ID:280 Subcategory: Compost → P10 ID:264, P11 ID:270
CATEGORY: Scrubber waters & mineral nitrogen concentrates Subcategory: Ammonium nitrate/sulfate → P12 ID:266, P13 ID:281, P14 ID:295, P15 ID:454, P16 ID:596, P17 ID:667

High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist with over 30% P_2O_5 content by "3R zero emission pyrolysis" process (ID:192)

ID 192:
https://www.agrocarbon.com

Country: Hungary, produced by 3R-Biophosphate Ltd.

Input material: food grade animal bone

Nutrient content: >30% P_2O_5 + >38% CaO.

Recommended crops: horticultural, fruits, grape, rice, tobacco.

Dosages: 0.2-1.5 t/ha.

Type of farming: conventional, low input, organic.

Terra-Preta biochar product recovered from wood chips and processed by “3R” high temperature pyrolysis process (ID: 1571)

ID 1571:
https://www.agrocarbon.com

Country: Hungary, produced by 3R-Biophosphate Ltd.

Input material: wood chips.

Nutrient content: 1% N - 0.2% P_2O_5 - 0.5% K_2O TC:>80 %

Recommended crops: Fresh vegetables and strawberries, permanent crops (fruit trees), grapes, rice, tobacco.

Dosages: 5-20 t/ha. The application rate for biochar depends on the specific soil type and crop management.

Type of farming: low input, organic.

PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID:401)

ID 401:

https://www.bmcmoerdijk.nl

Country: Netherlands, produced by BMC Moerdijk BV.

Input material: Ash from poultry manure.

Nutrient content: 0% N – 10% P_2O_5 – 12% K_2O – 20 % CaO - 7 % SO_3, 5 % MgO

Recommended crops: all.

Dosages: Depending on the P,K-nutrient needs of thecrop and the P,K-nutrient status of the soil.

Type of farming: conventional.

Struvite from waste water by "Canal de Isabel II S.A." process (ID:251)

ID 251:
http://www.canaldeisabelsegunda.es/inicio

Country: Spain, produced by Canal de Isabel II.

Input material: wastewater, $MgCl_2$ and NaOH.

Nutrient content: 5% N- 28% P_2O_5 – 0% K_2O %

Recommended crops: permanent grassland, cereals for the production of grain, root crops and plants harvested green from arable land by area.

Dosages: 0.100 t/ha.

Type of farming: conventional.

Struvite from digested sludge and wastewater by "NuReSys" process (ID:293)

ID 293:
http://www.nuresys-p.be

Country: Belgium, produced by NuReSys.

Input material: Digestate dewatering Liquor / Digestate / Wastewater.

Nutrient content: N: 5.6 - P: 12.6 - Mg: 10 (w/w %).

Recommended crops: Horticulture / Food & Feed Crop.

Dosages: to adapt according to specific crop demand.

Type of farming: conventional.

Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)

ID 210:

http://ambiente.aceapinerolese.it

Country: Italy, produced by ACEA Pinerolese

Input material: de-hydrated effluent from the anaerobic digestion o organic fraction of municipal solid waste, green residue from separate urban collection and dehydrated effluent from the wastewater treatment plant.

Nutrient content: 2.4% N (d.m.), 2.3% P_2O_5 (d.m.), 1.3% K (d.m.)

Recommended crops: potato, wheat, cabbage, pumpkin, cucumber, tomato, leafy vegetables, celery, leek and other crops – horticulture, floriculture, arboriculture.

Dosages: 10-30 t/ha (according to soil quality, season, crop uptake)

Type of farming: conventional, low input.

Compost from green waste and food wastes by "Biociclo" process (ID:260)

ID 260:

https://biociclo.it

Country: Italy, produced by Biociclo
Input material: biowaste, food waste collected door to door and green waste.
Nutrient content: 2.4% N (d.m.), 1,2% P_2O_5 (d.m.).
Recommended crops: potato, wheat, corn, cabbage, pumpkin, cucumber, tomato, leafy vegetables, celery, leek and other crops in agriculture – also use in horticulture, floriculture and arboriculture.
Dosages: 20-35 t/ha (according to soil quality, season, crop uptake).
Type of farming: conventional, low input.

Compost from green waste and pre-digested vegetable, fruit and garden wastes by "IOK Afvalbeheer" process (ID:272)

ID 272:

https://www.iok.be

Country: Belgium, produced by IOK Afvalbeheer.
Input material: VFG-waste and green waste (incl roadside cuttings,..).
Nutrient content: 1.79-2.1% N% (d.m.), 0.8-1.2% P_2O_5 % (d.m.), 1.1-1.8 K_2O% (d.m.).
Recommended crops: potato, wheat, cabbage, pumpkin, cucumber, tomato, leafy vegetables, celery, leek and other crops in agriculture – also use in horticulture, floriculture and arboriculture
Dosages: 10-15 t/ha (depenging on soil, season, crop,...)
Type of farming: conventional, low input, organic.

Green compost from green waste by "IMOG" process (ID:280)

ID 280:

https://www.imog.be

Country: Belgium, produced by IMOG.

Input material: Green waste (compostable, organic waste from gardens, parks, lawns and road sides; conformity with Vlarema).

Nutrient content: 1.22-1.62% N% (d.m.), 0.45-0.61% P_2O_5 % (d.m.), 0.87-1.26 K_2O% (d.m.).

Recommended crops: potato, wheat, cabbage, pumpkin, cucumber, tomato, leafy vegetables, celery, leek and other crops – horticulture, floriculture, arboriculture.

Dosages: 20-25 t/ha (depending on soil, season, crop,...)

Type of farming: conventional, low input, organic.

Liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264)

ID 264:

https://www.vlaco.be/vlaco-vzw/producten/agrogas-bv

Country: Belgium, produced by Agrogas bvba.
Input material: manure, organic wastes (cfr Vlarema (Flanders) and positive list FOD (B)) and/or energy maize.
Nutrient content: Dried solid fraction: 2.4-3.1 N% (d.m.), 3.7-5.5% P_2O_5 (d.m.),1.5-4.2% K_2O (d.m.) ; Liquid fraction: 5.7-9.9 N% (d.m.), 2.1-6.4% P_2O_5 (d.m.), 5.4- 8.9% K_2O (d.m.).
Recommended crops: cereals, fresh vegetables and strawberries, potatoe, sugar beet, fresh vegetables and strawberries, grapes, permanent crops (fruit trees), permanent grassland,
Dosages: Liquid fraction: on average 30 tonnes/ha (depending on soil, season, crop,…), Dried solid fraction digestate: on average 2 t/ha (depending on soil, season, crop,…)
Type of farming: conventional, low input.

High NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270)

ID 270:

https://www.facebook.com/arbiobvba/

Country: Belgium, produced by Arbio Bvba

Input material: mix of manure and organic waste

Nutrient content: 5.9 N% (d.m.) 3% P_2O_5 (d.m.)

Recommended crops: fresh vegetables and strawberry, potato, sugar beet, fresh vegetables, grapes, permanent crops (fruit tree), permanent grassland

Dosages: 4 t/ha (depending on soil, season, crop...)

Type of farming: conventional, low input.

Liquid ammonium sulphate or ammonium nitrate from digestate or slurries stripped and scrubbed with H_2SO_4 or HNO_3 by "Circular Values" process (ID:266)

ID 266:
https://circularvalues.eu

Country: Netherlands, produced by CIRCULAR VALUES B.V.

Input material: digestate or manure slurries.

Nutrient content: Minimum 7% N/t and 7% S Ammonium sulphate up to 18% N/t Ammonium nitrate (50% Ammonium-N and 50% nitrate-N).

Recommended crops: all.

Dosages: depending on N%, N-vulnerability of region, type of soil, season, crop, etc…).

Type of farming: conventional, low input.

Ammonium sulphate/nitrate from poultry manure by "Poul-AR®" technology (ID:281)

ID 281

https://www.colsen.nl

Country: Netherlands, produced by Colsen.

Input material: fresh poultry manure and sulfuric acid or nitric acid.

Nutrient content: 9% N (d.m.).

Recommended crops: all.

Dosages: +/- 1 m^3/ha (depending on soil, season, crop,…).

Type of farming: conventional.

Ammonium nitrate from liquid fraction of manure, digestate or other waste stream by "Detricon" process (ID:295)

Country: Belgium, produced by Detricon.

ID 295

https://www.detricon.eu

Input material: liquid fraction of manure, digestate or other liquid waste streams with an ammonia concentration > 0.1 m%.

Nutrient content: 18% N

Recommended crops: corn, grass, vegetables.

Dosages: 0.5-1 t/ha.

Type of farming: conventional.

Ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:454)

ID 454

https://www.colsen.nl

Country: Netherlands, produced by Colsen.

Input material: digestate, liquid fraction, pre-treated manure.

Nutrient content: (N-P-K %): 18-0-0 | 7-0-0

Recommended crops: corn, grass, vegetables.

Dosages: crop and soil depending.

Type of farming: conventional, low input, organic.

Ammonium sulphate from pig manure by on-farm scrubbing the air from the stables (ID:596)

ID 596

Country: Belgium, produced by Vancas CommV.

Input material: pig manure.

Nutrient content: 4.1% N.

Recommended crops: all crops, especially sulfur demanded.

Dosages: 1- 1.5 ton/ha, depending on crop demand and soil fertility.

Type of farming: conventional.

Ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by “BENAS” process (ID:667)

ID 667

https://www.gns-halle.de

Country: Germany, produced by GNS – Gesellschaft für.

Input material: maize silage and poultry manure.

Nutrient content: around 5% N in fresh weight.

Recommended crops: all crops in need of nitrogen, especially sulphur demanded.

Dosages: depend on the sulphur content and the crop demand.

Type of farming: conventional.

Presentation of the best NUTRIMAN N&P recovery technologies in agriculture

Results of the selection:

Technology (8)
CATEGORY: Thermochemical nutrient recovery .
CATEGORY: P precipitation from liquid manure, waste water and drain water.
CATEGORY: Physic-chemical nitrogen recovery from manure, digestate and wastewaters: separation, stripping and membrane processes. Subcategory: Nitrogen recovery from air → T1 ID:273. Subcategory: Stripping + scrubbing → T2 ID:296, T3 ID:455, T4 ID:668.
CATEGORY: Biological nutrient recovery: composting, anaerobic digestion Subcategory: Composting → T5 ID:261, T6 ID:292. Subcategory: Composting → T7 ID:209, T8 ID:271.

Technology for N recovery as dried digestate and ammonium sulphate from solid fraction digestate with "Biogas Bree" chemical scrubbing of exhaust air during drying process (ID:273)

ID 273

https://biogasbree.be

Country: Belgium.
Owner: Biogas Bree
Input material: animal manure, organic waste (conform Vlarema and positive list FOD), energy maize.
Output product: post-treated digestates including dried digestate and ammonium sulphate.
Processing capacity: production of solid fraction (5,000 t/y) – non animal manure status –, liquid fraction digestate (45,000 t/y) – non animal manure status –, dried digestate (1,500 t/y) – manure status –, ammonium sulphate (200-500 t/y).

Technology for N recovery as inorganic fertilizer starting from liquid fraction of manure, digestate or other waste streams with "Detricon" stripping and scrubbing process (ID:296)

ID 296

https://www.detricon.eu

Country: Belgium.
Owner: Detricon
Input material: liquid fraction of manure, digestate or other liquid waste streams with an ammonia concentration > 0.1 m%
Output product: inorganic fertilizer.
Processing capacity: 100-5,000t/y inorganic fertilizer production.

Technology for N recovery as ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:455)

ID 455

https://www.colsen.nl

Country: Netherlands.
Owner: Colsen.
Input material: whole digestate or liquid fraction.
Output product: ammonium sulphate or ammonium nitrate.
Processing capacity: from 1 to 500 ton/hour.

Technology for N recovery as ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by “BENAS” process (ID:668)

ID 668

https://www.gns-halle.de

Country: Germany.
Owner: GNS – Gesellschaft für.
Input material: maize silage and poultry manure.
Output product: ammonium sulphate.
Processing capacity: AmS output 5-40 t/d, Lime output 1,5-14 t/d.

Technology for N&P recovery as compost starting from green waste and food residues with "BIOCICLO" aerobic digestion process (ID:261)

ID 261

https://biociclo.it

Country: Italy.
Owner: Biociclo.
Input material: yard trimming, rotting vegetable matter, food residuals.
Output product: high quality compost.
Processing capacity: 69,000 t/year of waste.

Technology for N&P recovery as compost starting from organic waste with farm composting process (ID:292)

ID 292

https://ilvo.vlaanderen.be/nl

Country: Belgium.
Owner: Ilvo.
Input material: crop residues and other farm organic materials (manure, wood, others).
Output product: Farm compost: mix of stable organic matter, mineral fraction and nutrients.
Processing capacity: depends on the farm.

Technology for N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)

ID 209

https://ambiente.aceapinerolese.it

Country: Italy.
Owner: ACEA Pinerolese Industriale S.P.A.
Input material: municipal organic waste.
Output product: biomethane + digestate (sludge quite stabilized and hygienized).
Processing capacity: 60,000 t/y of organic waste.

Technology for N&P recovery as compost starting from vegetable, fruit and garden wastes with "IOK Afvalbeheer" anaerobic digestion and composting process (ID:271)

ID 271

https://www.iok.be

Country: Belgium.
Owner: IOK Afvalbeheer.
Input material: vfg-waste (vegetable-fruit-garden waste) – Vlarem- conform – including kitchen-waste, green waste (from parks, public domain,..).
Output product: vfg-compost
Processing capacity: 25,000 ton vfg-compost/y.

Nutrient Management and Nutrient Recovery Thematic Network

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