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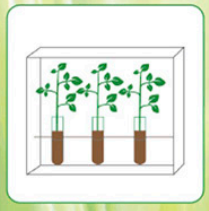
SCIENCE - IMPROVING AGRICULTURE

RESEARCH & DEVELOPMENT FOR AGRICULTURE, HORTICULTURE, NURSERY, AMENITY

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DATE
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CLIENT
OM Technologies

PROJECT

Carbon 90: Nitrates release curve

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1) Leaching test

Trial description:

The trial has been performed in pots 15 x 15 cm (3.5 L), filled with a sandy soil substrate (30% soil + 70% Silica Sand). One gram of Nitrogen per liter of potting soil was placed in pot rinsed with the sandy-soil substrate.
Pot preparation: The Fertilizer were mixed in 1 liter (≈ 1,4 kg) of sandy-soil substrate, then a layer of free substrate was add to each pot till reach 3 cm form the upper edge. Water was provided as sub-irrigation (Fig. 1, 2, 3, 4). The weekly nitrogen (N) release from the prototype formulations was measured at 22±0.8°C; the pots were kept in a growth chamber with a controlled temperature environment.

The volume of leachate was recorded and subsampled for nitrate-N.
Each treatment was replicated six times and the nutrient release of the nitrates profiles was determined.

Entries
1. Carbon90
2. Urea 2/3 M
3. NPK 15.7.15
4. Control

Trial Design: Complete randomized
No. entries: 4

Assessment
- Leaching events applied 1 per week for 4 months.
- The volume of the leachate fractions as well as the nitrate content was analysed in order to build the release curve.
- The total nitrates were quantified in the leachate fraction. The total nitrates were quantified in the leachate fraction.

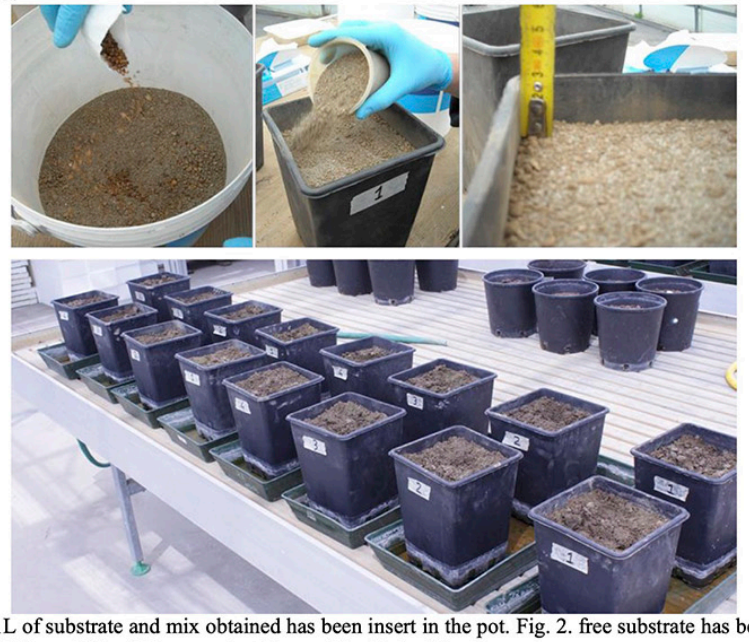

Fig. 1. the fertilizer is mixed in 1L of substrate and mix obtained has been insert in the pot. Fig. 2. free substrate has been add on the top Fig. 3. until reach 3 cm from the top of the pot. Fig. 4. Panoramic picture of the trial setting.

The Nitrogen cycle

The Nitrogen fertilisers can be provided in different N-forms: as nitrates, ammonia and urea as the most common.

- Urea needs to be first transformed to ammonia in order to be absorbed by the plants. Is highly soluble and can be lost by leaching.
- Ammonium can be directly absorbed by the plants, but has a somewhat slower effect, indeed it has to be first absorbed to the soil particles and then released. Ammonium can be lost by volatilization.
- Nitrate based fertilisers are immediately available and they act quickly but are also sensitive to leaching.

All these *phenomena* are controlled by several conditions like soil humidity, temperatures and rain events. A reduction in waste process reduces the risk of environmental pollution and increases the amount of N available for the plants.

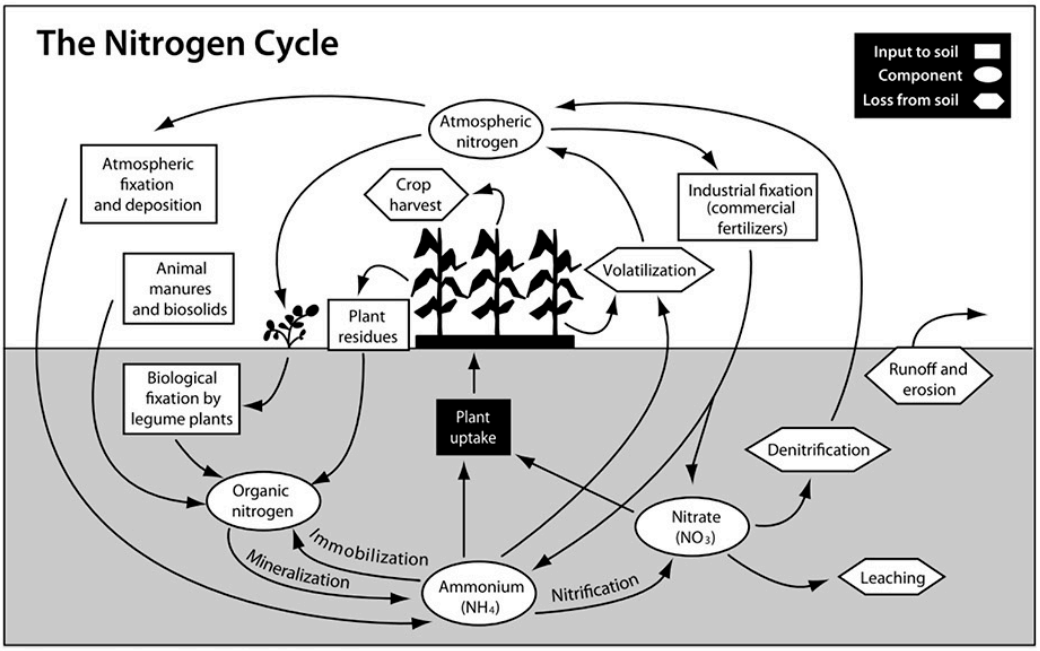

Fig. 5 Conversion of N in the soil and global N cycle

Leaching test

Several sequential leaching were applied on the pots, with a frequency of 7-10 days between each other. Before each leaching events, the pots were fully saturated by sub-irrigation; once fully watered, 800 ml per each pot was applied and the leachate fraction were collected.
The assessments performed on each fraction were:

- EC
- Volume of water
- Nitrate content

EC

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water; the values are referred to nitrate ions (ammonia and nitrate), phosphorous and potassium.
As reference, the water used for the leaching events records 0.45 mS.
Initially the conductivity measured on the leachate fractions were extremely high, especially for the Carbon 90; the conductivity depends in this case by the NPK content. All the other entries recorded a lower EC, around 2-4 mS. To note that the NPK 15.7.15 and Urea 2/3 M, that are CRFs recorded a notably lower EC in comparison to Carbon 90, thus showing that in the CRF the release of nutrients is slower.
During the following weeks, a natural decrease in the conductivity was recorded for all the entries. The decrease is congruent with the reduction of nutrients in the leachate fractions (Fig. 6).

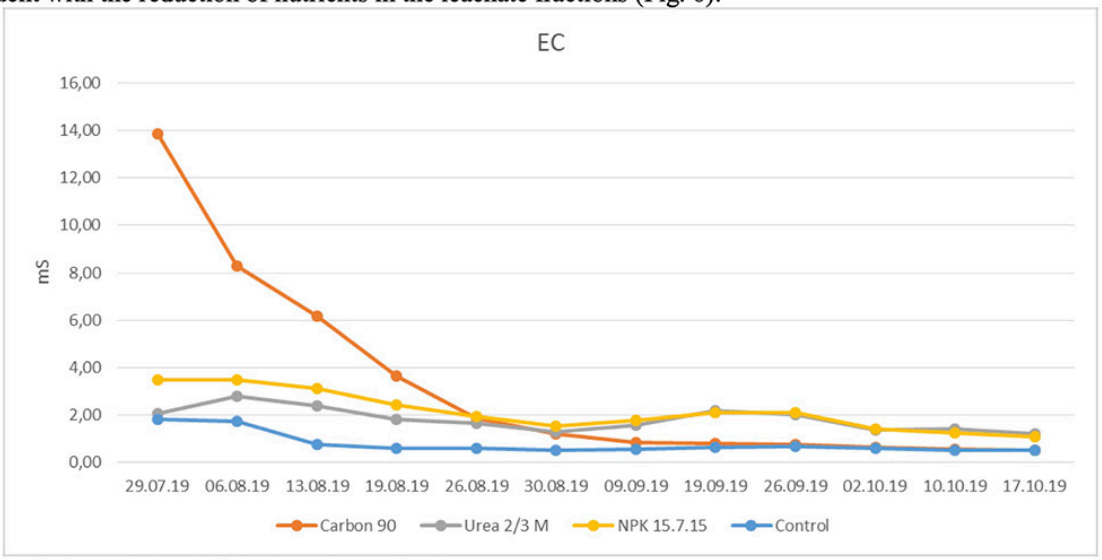

Fig. 6 Trends of the EC measured in the leachate fractions.

NO3 released

The NO3 released expressed in mg/L was measured by means of Laqua Twin Nitrate Meter. The value was multiplied on the basis of the volume of the leachate fractions in order to equalize the amount of nitrates with the amount of volume.

The values recorded were extremely high at the beginning of the experiment and then a gradual decrease was assessed. A second peak of release was observed on 19.09, then a progressive reduction in the nitrate content was evident for all the entries. At the end of the experiment, the entry Carbon 90 had a null release, showing that in this entry, the release of all the possible nutrients was completed; on the contrary, urea 2/3M and NPK 15.7.15, two CRFs had still some nitrates that were progressively released in the leachate fractions (Fig. 7).

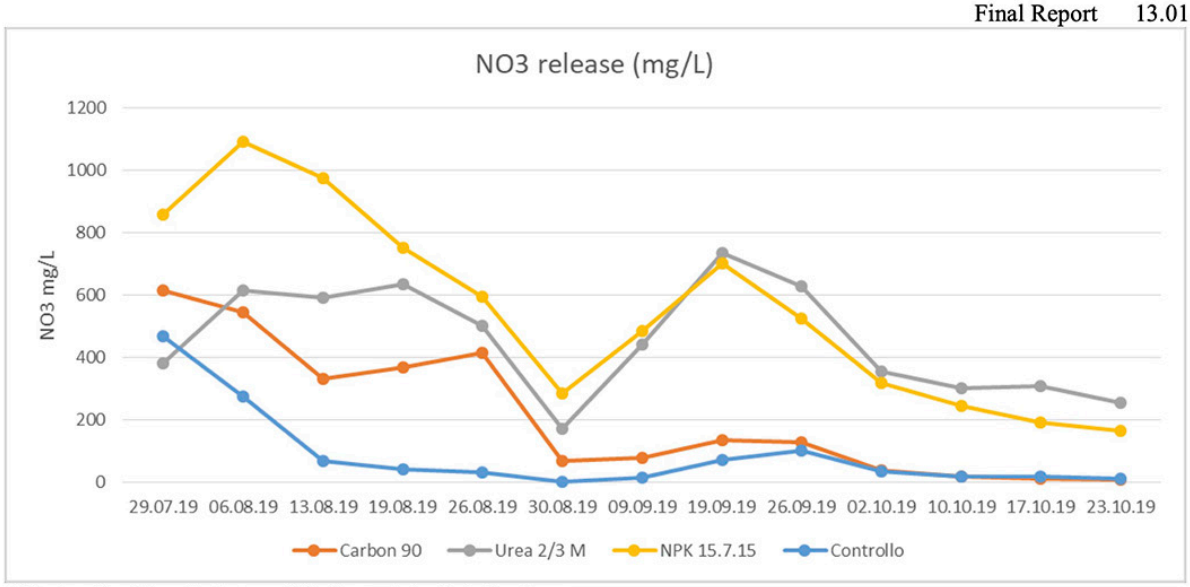

Fig. 7 the trends of the nitrates quantified in each leachate fractions.

The cumulated nitrates were measured as the sum of nitrates mg released in the sequential fractions of leaching. The statistical analysis is reported in Tab. 1 and the trends in Fig. 8.

The two CRF products behaved differently form the others; the urea 2/3 M released 5927 mg and NPK15.7.15 released 7192 mg.
On the contrary the product Carbon 90 released a significant less amount of nitrates that were observed in the leachate fractions. It recorded 2767 mg.

	29.07.19		06.08.19		13.08.19		19.08.19		26.08.19		30.08.19		09.09.19		19.09.19		26.09.19		02.10.19		10.10.19		17.10.19		23.10.19	
Control	468,3	ab	834,8	a	915,6	a	956,3	a	987,6	a	989,9	a	1004,8	a	1076,4	a	1179,0	a	1214,9	a	1234,7	a	1254,7	a	1266,6	a
Carbon 90	616,3	b	1163,2	b	1494,0	b	1863,8	b	2279,6	b	2346,5	b	2424,7	b	2559,9	b	2688,0	b	2728,1	b	2745,7	b	2758,6	b	2767,2	b
Urea 2/3 M	381,1	a	997,2	ab	1591,1	b	2226,9	c	2729,2	c	2899,5	c	3341,3	c	4076,7	c	4704,6	c	5060,1	c	5363,5	c	5671,4	c	5927,8	c
NPK 15.7.15	858,7	c	1951,3	c	2926,0	c	3677,8	d	4274,4	d	4558,5	d	5044,9	d	5746,9	d	6273,5	d	6591,6	d	6835,5	d	7027,1	d	7192,2	d

Tab. 1 Statistical analysis of the cumulated nitrates recorded in the leachate fractions (mg). The analysis was performed by means of one-way Anova test, using the Duncan test and α=0.05. The software used is Statistica.

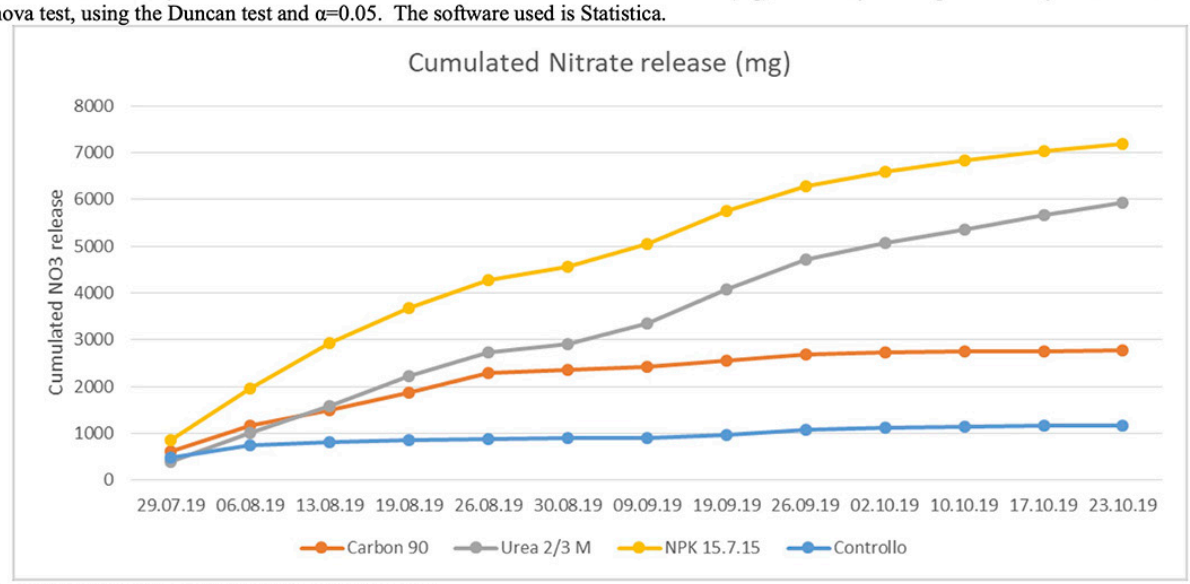

Fig. 8 the trends of the cumulated nitrates quantified.