Study of the evolution of various products from a wastewater treatment plant as fertilizer in acid and basic agricultural soil

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Introduction

Research into processes that allow the recovery of waste from production chains are a very important tool for the implementation of the **circular economy** in the current economic model, due to the increasing difficulty in obtaining raw materials. A good example is obtaining **phosphorus** in different forms for use as a fertiliser in agriculture.

With this objective in mind, *Navarra de Infraestructuras Locales S. A.* (NILSA) and the Public University of Navarra (UPNA) have collaborated in a project to test the effect of **different by-products derived from wastewater treatment** on agricultural soils in Navarre (Spain) to evaluate their role as possible **fertilisers**.

Objectives

The **main objective** of this project is the **evaluation** from an agricultural point of view of several products obtained by different processes in the **waste water treatment plants** (WWTPs) of Arazuri and Tudela (Navarre, Spain).

Materials and methods

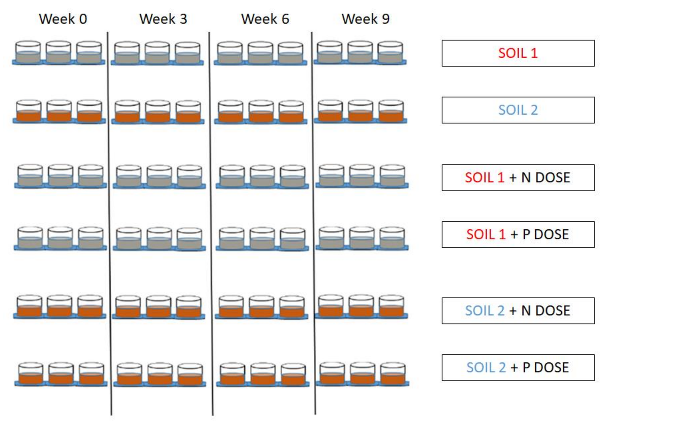
The experiment consisted of a **laboratory-scale test** by incubating soil mixtures with **four products**:

	Treatment	WWTP location	Dry matter (%)	Total N (%)	P (P_2O_5, %)	K (K_2O, %)	Organic C (%)
Product 1	Sun drying sewage sludge	Arazuri	53.5	5.86	7.4	<1	33
Product 2	Drying at the WWTP sewage sludge	Arazuri	18.0	6	6.0	0.37	40
Product 3	sewage sludge with precipitated phosphorus	Arazuri	12.0	6.85	3.4	0.502	18
Product 4	sewage sludge with precipitated phosphorus	Tudela	19.6	3.78	6.5	<0.3	13.5

The incubation of each product lasted a total of **9 weeks**, where they were mixed with soil and kept in optimal conditions of temperature (25ºC) and humidity (between 60% and 100% of the field capacity point of the soil). The soils used were **two agricultural soils** with different physico-chemical properties and pH values. The control and monitoring of the trial was carried out in weeks 0, 3, 6 and 9.

Analysis:

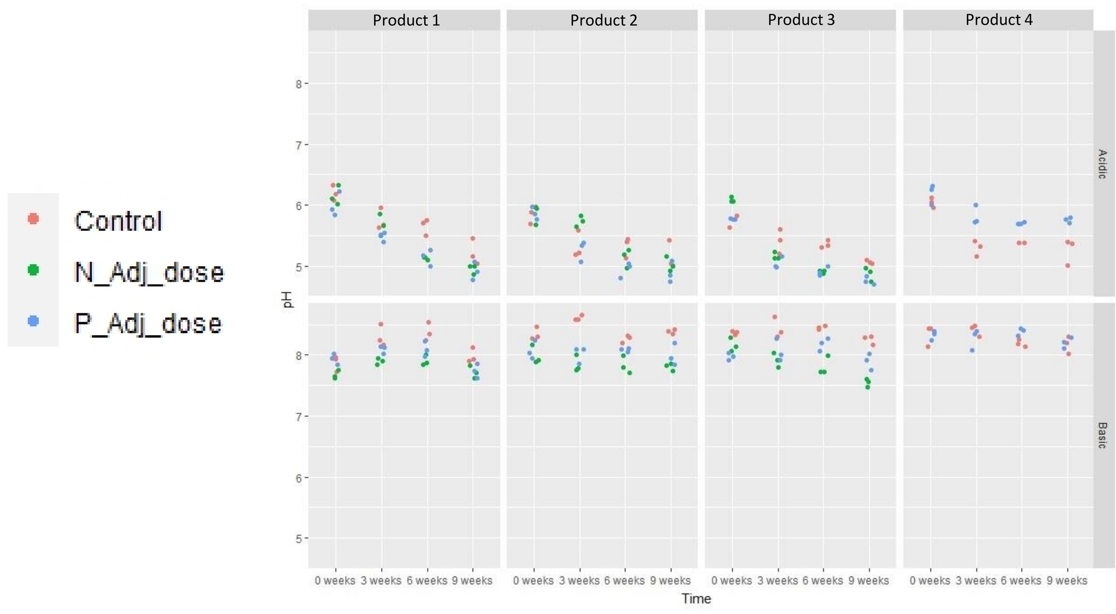
- pH and EC
- Available phosphorus
- TKN
- N min (NO_3^- + NH_4^+)

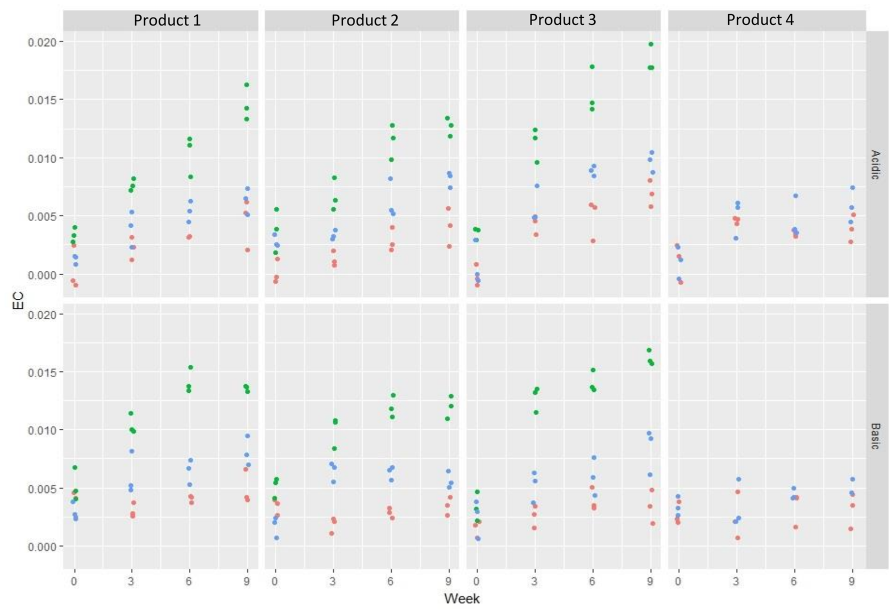


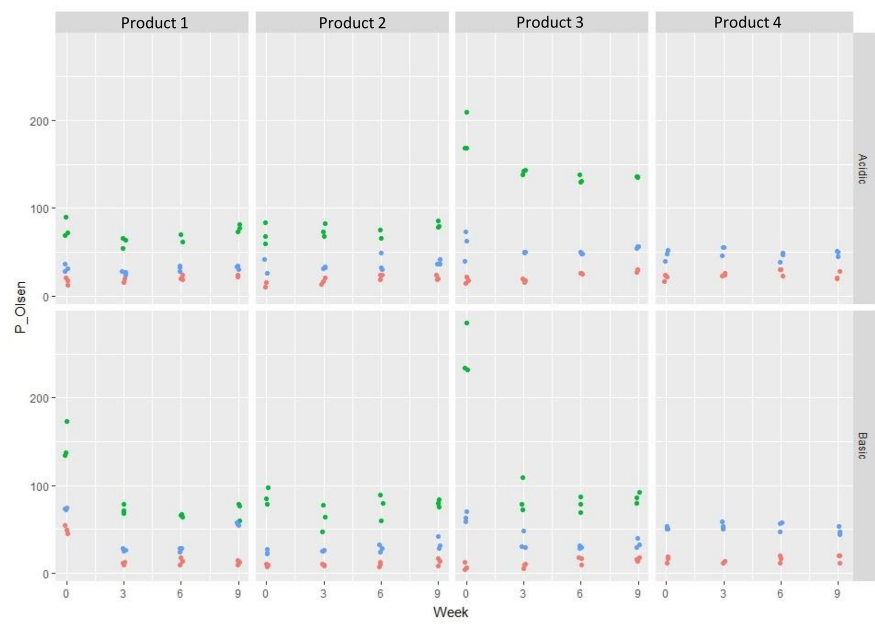
Product 4 does not have the adjusted nitrogen dosage because of fungal growth.

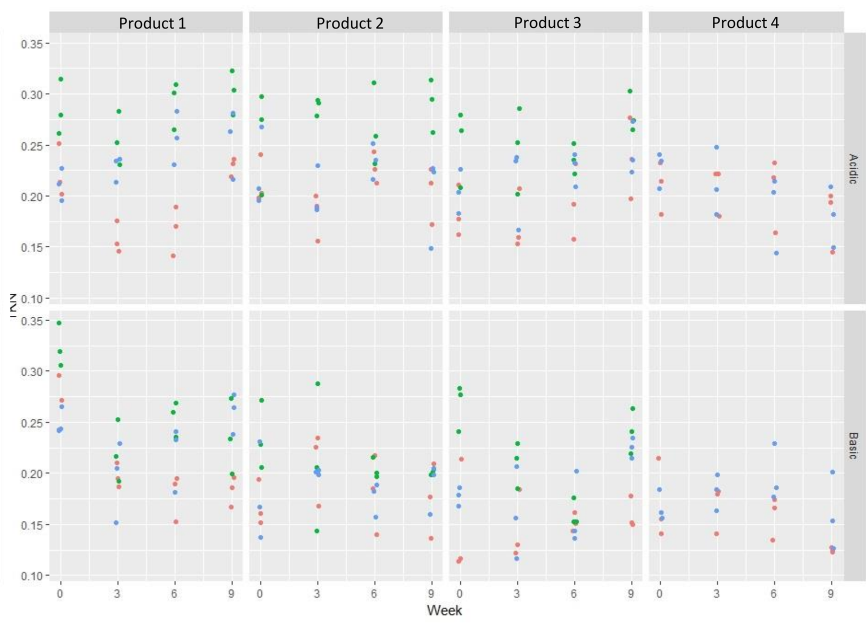
Results

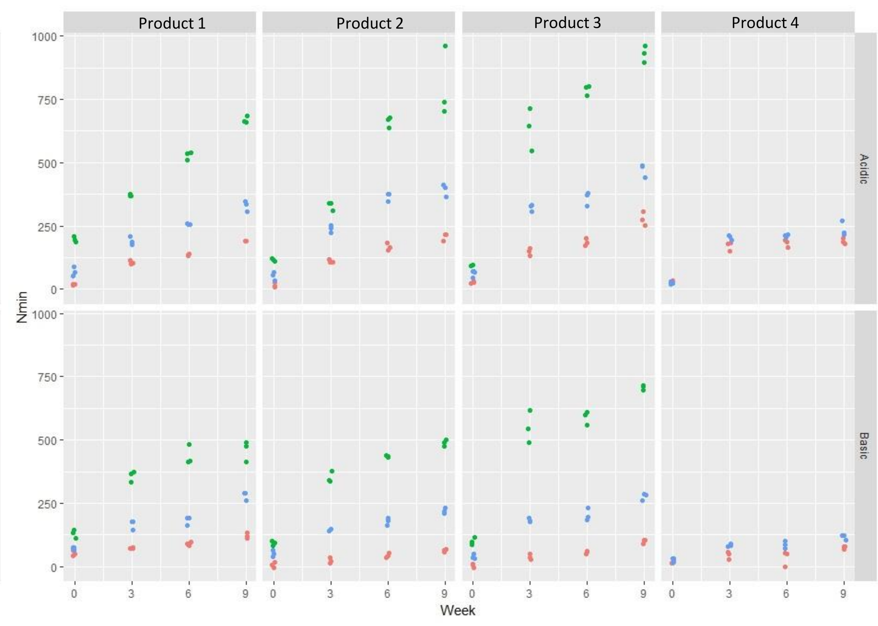
- **pH:** Acidification is observed in all cases. In acid soils as a function of time and in basic soils as a function of dosage.
- **EC:** The electrical conductivity increases in all cases. The higher the dose, the greater the increase in EC.
- **P Olsen:** P Olsen or available P also shows an increase with increasing dose, which remains stable over time.
- **Nitrogen:** No differences are shown in the TKN in time. N min increases with both time and dose, probably due to nitrification.











Conclusions

- Its application in soils causes an **acidification** of the medium as incubation progresses, possibly related to the nitrification process.
- **Conductivity increases** in both soils and during the whole test as the amendments add soluble salts to the soil and the trial lacks drainage. However, the increase in salt content was not very high.
- The presence of the amendment causes **a stimulation of the biological activity** of the two soils, activating N mineralisation.
- The application of the products causes an initial **increase in P Olsen**, which is maintained over time.
- All the products have very **similar behaviour**, so their effect as an amendment is very similar.

Future research line

Plant trials of various products are being carried out in a greenhouse and a phytotron (24ºC, 16 h light, 8 h darkness). The plant of choice was lettuce, due to its short growing period.

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