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NITROGEN NUTRITION INDEX: A KEY INDICATOR OF THE AGRONOMIC DIAGNOSIS IN PEA

Authors: Véronique Biarnès[a*], Lola Vergnaud[a], Agathe Penant[b], Bastien Remurier[c], Xavier Pinochet[a]

WorkCenter :[a]Terres Inovia, Avenue Lucien Bretignières, 78850 Thiverval-Grignon, France. [b]Terres Inovia, 270 avenue de la Pomme de Pin, 45160 Ardon, France. [c]Terres Inovia, Bâtiment France Luzerne, Complexe agricole du Mont Bernard, Route de Suippes, 51000 Châlons-en-Champagne, France. *Presenting author: v.biarnes@terresinovia.fr

Objectives:

In the context of the climate change and of pesticids reduction, diversification of crops can give solutions to improve the services given by the agro-ecosystems. Pea, as a legume crop, is autonomous for nitrogen, which can help to the agroecologic transitions. However, it was observed from the 5 last years in France that yields are low for this crop. Climate, drought stresses in particular and high temperatures during flowering period, lead to an important limitation of seed number produced (Guilioni et al., 2003) and are often cited to explain these low perfomances (Benezit et al., 2017). Furthermore, Nitrogen Nutrition Index (NNI), calculated at the beginning of flowering, each year in variety trials network for winter and spring pea, suggest that limiting factors are present at the beginning of the cycle, and may induce a default in nitrogen nutrition, which can reduce yield but also protein content in the seeds. The objective of the study presented here was to identify the limiting factors of NNI in a fields plots network in France in 2021 and 2022 (Cap Protéines project).

Concise description of the work:

NNI was calculated from the measures of dry matter and nitrogen content in the plant in nearly 140 fields plots. Some information relative to the crop management (sowing date, soil type), climatic data, quantity of nodules or pests attacks (weeds, diseases, insects) were recorded.

Main results:

- For spring pea, NNI values are more often lower than 1 than for winter pea (Figure 1), which indicates that nitrogen nutrition is more often limited for this type of pea and 2022, drier year than 2021, led to significant lower values of NNI.
- Soil type could also explain differences in NNI. Indeed, weak values were measured for the both types of pea in calcareous soils, especially in the Center-West and the North-East of France (Figure 2).
- Some climatic variables such as number of days of maximal temperatures above 25°C and water balance from emergence to beginning of flowering (BF) have an impact on NNI for spring pea. This underlines the need of good water and mild temperature conditions to promote nodulation.
- NNI is also related to the quantity of nodules, counted at BF.

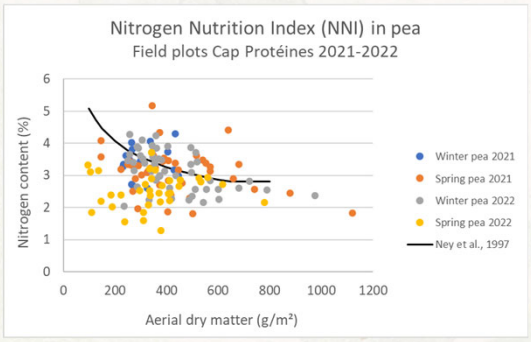

Figure 1: Nitrogen Nutrition Index measured in 137 French fields in 2021 and 2022. Aerial dry matter and nitrogen content measured in pea plants were positioned relative to the dilution curve established for pea by Ney et al. 1997.

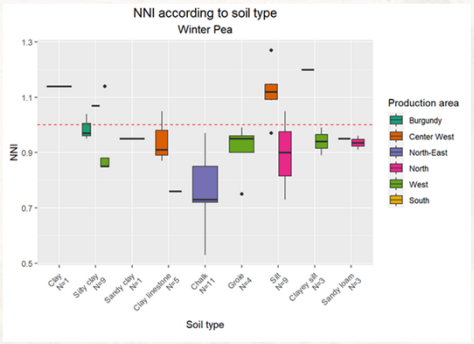

Figure 2: Relationship between NNI and soil type according to the production area for winter pea

Field plots with low quantity of nodules at BF achieved low NNI and low yields

Conclusions:

As shown in our results, soil type and climate could have great effects on the NNI and on the state of nodules. The same effects are found when data collected on both winter and spring pea in 2023 are added. Some results are in line with those obtained on soybean in another study of Cap Protéines project: drier conditions in 2022 than in 2021 led to lower values of NNI. For spring pea, levers to improve the start of nodulation and achieve satisfactory NNI at BF could be early irrigation or date shift in order to escape limiting factors at the beginning of the cycle. A further study on soils would also be necessary to determine wether the pH or the calcareous content can limit NNI.

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