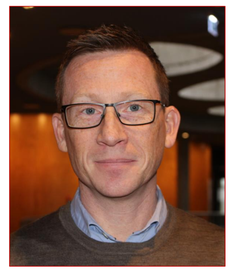
UNIVERSITY OF COPENHAGEN
DEPARTMENT OF PLANT AND ENVIRONMENTAL SCIENCES

THE IMPACT OF PLANT NUTRIENTS ON THE PERFORMANCE AND QUALITY OF LEGUMES FOR PLANT-BASED FOODS



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Introduction

Plant nutrients are the building blocks of all primary and secondary metabolites in plant tissue (Table 1). Due to the ability of legumes to conduct Biological N_2 Fixation (BNF), optimization of nutrient availability by fertilization strategies for legumes is rarely considered. It is thus very likely that many legume species are nutrient deficient, which potentially reduces the performance and quality of legume crops (Figures 1-2).

Essential plant nutrients

Table 1: Essential plant nutrients and selected roles that influences legume performance and Biological N_2 Fixation (BNF). *Cobalt is considered a beneficial plant nutrient.

Nutrient	Functional roles in legumes and for BNF
Nitrogen (N)	Chlorophyll, amino acids, proteins and hormones, inhibits nitrogenase, leghaemoglobin and BNF
Potassium (K)	Osmotic regulation, cation-anion balance, stomatal regulation, turgor, enzyme activation, carbohydrates to nodules
Calcium (Ca)	Signalling, structural element, stabilization of cell walls, nodulation and nodule structure
Magnesium (Mg)	Photosynthesis, enzyme activation, protein synthesis
Phosphorus (P)	Nucleic acids and phospholipids, energy metabolism, signalling and energy supply in nodulation
Sulfur (S)	Amino acids, proteins, secondary metabolites, nitrogenase activity, leghaemoglobin content
Chlorine (Cl)	Photosynthesis, stomatal regulation
Boron (B)	Stabilization of cell walls, nodule formation and structure
Iron (Fe)	Photosynthesis, electron transport, enzyme activation, in nitrogenase, ferredoxin, leghaemoglobin and hydrogenase
Manganese (Mn)	Photosynthesis, enzyme activation, lignin biosynthesis, ureide metabolism
Zinc (Zn)	Enzyme activation, rhizobia growth, nodule number and size, leghaemoglobin content
Copper (Cu)	Enzyme activation, lignin biosynthesis, nodulation
Nickel (Ni)	Urease activity, ureide metabolism
Molybdenum (Mo)	Enzyme activation, N assimilation, in nitrogenase
Cobalt (Co)*	In cobalamin coenzyme B12, synthesis of heme groups of leghaemoglobin and bacterial cytochrome

Impacts of nutrient deficiencies

Figure 1: The impact of sulfur deficiency on legume performance. Peas grown with low, medium or high sulfur supply (left to right). The impacts of nutrient deficiencies in legumes are poorly understood.

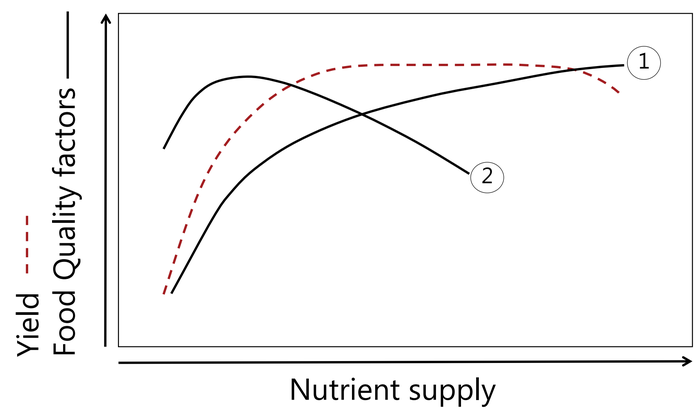

Figure 2: The impacts of nutrient supply on harvest yield versus quality of plants. As an example – excessive supply of essential nutrients may lead to high yield and protein content (1), however, the highest protein quality may be obtained at nutrient supplies that are suboptimal for harvest yield (2). For legumes these relations must be further explored.

Conclusion

Nutrient deficiencies have major impacts on the performance of legumes but the effect on food quality should be further explored. Harvest yield and food quality parameters are rarely positively correlated and superior food quality may be obtained at nutrient supplies that are excessive or suboptimal for harvest yield. **Plant nutrition and fertilization strategies should therefore be taken into consideration when growing legume crops for plant-based foods.**

References and acknowledgments

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