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# Field pea and nitrogen in the crop rotation

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## Summary

Pea compared to barley allows a reduction in following crop fertilisation of 20 kg N/ha for maize, of 40 kg N/ha for winter rye and of 60 kg N/ha for winter rape. This represents a 10 to 15% savings of non-renewable energy. Absence of nitrogen fertiliser on pea accounts for a 30% savings.

## Introduction

Quantifying fertilising effect of grain legumes in crop rotation has two goals: fixed nitrogen available to following crops corresponds to a potential fertiliser and non-renewable energy savings, taking into account this amount of nitrogen in fertilisation planing helps to limit nitrate losses after grain legumes. Being a very effective $N_2$-fixing legume pea plays an important role in this context (2, 4). It is necessary to manage favouring conditions for $N_2$ fixation (1) and to benefit efficiently of it; overall balance of nitrogen cycle linked with pea cultivation needs also fine interpretation (3). The aim of this work was 1) to quantify nitrogen availability to crops following pea, 2) to identify crops profiting the most from residual nitrogen and 3) to quantify nitrogen balance at crop and rotation level.

## Material and methods

The residual N effect of spring pea (*P. sativum*) and of winter barley (*H. vulgare*) was compared on succeeding winter rape (*B. napus*), winter rye (*S. cereale*) and maize (*Z. Mays*) preceded by a *phacelia* cover crop. Each following crop was cultivated at four nitrogen doses. They were followed by winter wheat (*T. aestivum*). The residual N effect of pea compared to barley was identified as the differential N level applied to following crops in order to obtain optimal equivalent yield. Different criteria were used to assess this equivalency principle. Nitrogen balance for each crop sequence was based on optimal fertiliser dose and N immobilised in straw and grain.

## Results and discussion

Highest yields were obtained after pea; a similar trend was also observed for grain and straw nitrogen content. Different criteria used to assess potential savings after pea showed important variations (e.g. from 0 to 100 kg N/ha for rape) depending on interpretation of yield equivalency. Concordant estimates showed that pea compared to barley allows a fertilisation reduction on following crop up to 20 kg N/ha for maize, from 30 to 40 kg N/ha for rye and from 40 to 60 kg N/ha for rape (fig. 1).
A residual effect on wheat after two years was observed. Yield increase reached about 10% after pea / maize and pea / rape and 25% after pea / rye. It could be interpreted as a fertilising and a phytosanitary effect by pea. Especially rye after barley increased the presence of diseases on wheat.
Fertilisation value of pea and durability of effects on the rotation differed according to the succeeding crop and growing conditions. Consequently, rotation with pea needs

an effective $N_2$ fixation, an adjusted crop rotation and adapted crop management practices to improve efficiency of nitrogen fixation and valorization (5) and to limit nitrate losses.
Nitrogen balance at crop and rotation level showed that main differences come from absence of nitrogen fertiliser on pea, from nitrogen quantity exported by pea grain and from savings of fertiliser on the following crop (fig. 1). This corresponds to a reduction in fertiliser use equal to 140 kg N/ha and to an increase of 80 kg/ha of N exported by grain over 2 years. Only rotations with pea exported more nitrogen than needed for fertilisation. Absence of nitrogen fertiliser corresponds to a 30% reduction in non-renewable energy needed for pea cultivation as compared to barley. Savings in fertiliser on crops following pea represents 10 to 15 % decrease in energy for rape and 10% for rye.

## Conclusions

Favourable nitrogen balance and savings in non-renewable energy motivate to integrate more grain legumes in crop rotation. Autumn sown species show best potential to take benefit of nitrogen left by grain legumes. Tools to predict opportunity to reduce fertilisation after grain legumes as function of soil and climate conditions need to be developed.

## References

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Fig. 1. Nitrogen balance according to optimal fertiliser dose and N immobilised in straw and grain for two years rotation sequences: winter barley / winter rape (WB / WRa), spring pea / winter rape (SP / WRa), winter barley / winter rye (WB / WRy), spring pea / winter rye (SP / WRy), winter barley / maize (WB / WMa), spring pea / maize (SP / WMa).