TOWARDS PROTEIN self-sufficiency

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ARVALIS simulated the impact of introducing lucerne (alfalfa) on a model mixed farm. Although this legume reduces the farm's dependency on protein concentrates, the economic outcome is pretty neutral in the end. Other factors should however be taken into account in order to appreciate the overall effect of such a change.

The price of protein concentrates, which need to be added to dairy cow rations, has soared over the last few years. For instance, the cost of soybean meal alone rose by nearly 37% over the 2012-2013 dairy season. One of the possible solutions for reducing this expenditure item is to produce protein on the farm. Among the candidate crops, lucerne (alfalfa) is considered an ideal one. This leguminous fodder plant is indeed reputed to be more productive and more resilient against climatic variations than the other grassland species. It is nonetheless demanding from an agronomic point of view and is labour intensive at harvest time. Since 2011, ARVALIS has established several reference data acquisition experiments focusing on harvest and preservation of this crop. In order to assess the technical and financial impacts of introducing this legume into mixed farming systems (various crops and dairy cattle), the Institute carried out in 2015 a series of simulations on a "model" farm in the Pays-de-la-Loire region *(insert)*.

Profound technical changes

The study is based on the premise that the "virtual" farm is self-sufficient in fodder and that supplementary energy is provided by on-farm wheat. Lucerne is integrated into the rotation for four years (10 t of harvested DM per ha). It is incorporated into winter rations, at a level of 4 kg DM/cow/day (silage bale or hay) and partially replaces protein concentrates whilst maintaining milk performance. Simulations were carried out for six different economic contexts, i.e. from the 2009-2010 to the 2014-2015 dairy seasons.

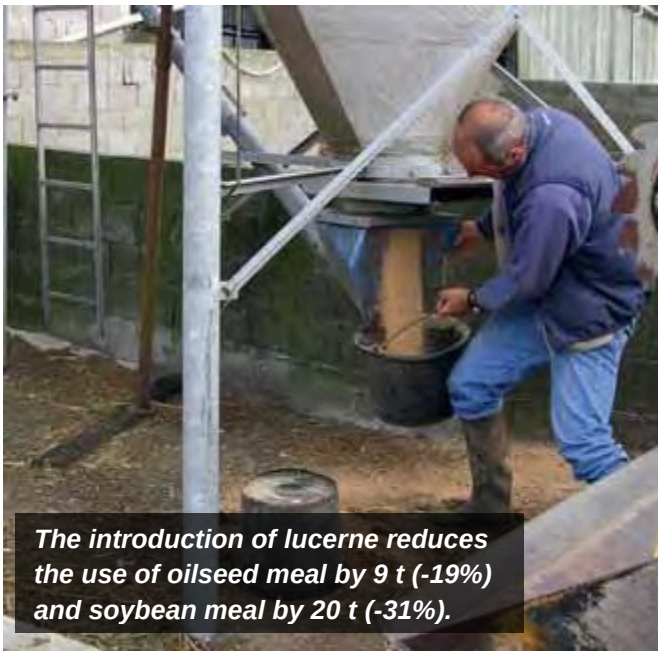
Results show that the introduction of lucerne induces deep structural changes, and affects various technical expenditure items. For example, it has an impact on rotations and block plans: with around 10 ha of lucerne, cereals and oilseed crops remain at 76 ha, whereas the forage maize area decreases slightly (-11 ha). With this case scenario, the introduction of lucerne reduces the use of oilseed meal by 9 t and soybean meal by 20 t, i.e. -19% and -31% respectively. However, the lower energetic input from lucerne sees the consumption of a greater proportion of on-farm wheat (+58 t), i.e., +74%, which represents nearly 8 ha.

Conversely, the total amount of ingested fodder decreases. The same goes for the amount of purchased fertiliser used. The need for nitrogen is reduced by 9 kg/ha, firstly through replacing part of the maize silage with lucerne (which does not require any nitrogen input), but also because of the smaller proportion of wheat (the crop with the highest need for mineral nitrogen) on the farm. In addition, for the next two years, the crops grown after lucerne has been destroyed, require a lower nitrogen input.

Low environmental impact

It also triggers changes in plant protection product use. With the above lucerne scenario, the model farm's average TFI (treatment frequency index) goes from 2.05 to 1.97. This slight reduction is due to various factors. Firstly, the average TFI for lucerne is 0.9, whereas maize's, which it replaces, is 2.6. However, changes to the overall block plan offset this reduction, as the oilseed rape block increases, with a much higher TFI (5.42) than the other crops. The other changes in the block plan have little impact as the other crops that have seen their surface area modified have very similar TFIs (wheat = 2.8, barley = 2.7).

But the establishment of lucerne in this system does reduce the surface area on which spring crops alternate with winter crops. This drops from 45 ha to 24 ha, which, besides helping to meet regulatory requirements in vulnerable zones, also ensures ground coverage over winter.



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Better level of self-sufficiency but mixed economic outcome

Introducing lucerne significantly improves feed self-sufficiency as it replaces purchased concentrates. It goes from 40 to 61% for dry matter (mass self-sufficiency), and from 15 to 30% for the overall nitrogen matter (protein self-sufficiency). However, in spite of a systematic drop in cost, the improvement in feed self-sufficiency does not result here in a better overall economic outcome at farm level. It is therefore particularly important to consider changes at that level. The energetic supplementation with on-farm wheat –which then cannot be sold– is one of the main reasons for the financial outcome. In this study, lucerne partially replaces maize silage and purchased protein concentrates. The economic benefits of lucerne are even greater as its yield (Ly) nears or overtakes that of forage maize (FMy). In this study, the Ly/FMy ratio is 0.91. In cases where Ly/FMy > 1, intensification of the forage area frees up land for cash crops, which increases the chances of generating a better economic outcome.

Also, the price of protein concentrates, in itself isn't enough to determine whether the introduction of lucerne will be cost-effective. The protein concentrate price Vs (unsold) wheat price appears to be a better indicator. The higher the "purchased protein concentrate price/wheat price" ratio is, the more the introduction of lucerne is likely to be economically beneficial. In this study, the highest ratios (2.8 and 2.7) occurred during the 2009-2010 and 2014-2015 seasons.

Finally, although this has not been discussed here, the distance from the lucerne parcels is also a point that must be taken into account. Harvested in four cuts, lucerne requires a large number of operations: 12 to 20 per field depending on the harvesting method used (not counting sowing and transportation of harvest). Time and cost of this transport may modify the economic outcome slightly.

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Other possibilities are being studied

To be successful, lucerne requires technical skills as well as favourable weather conditions at certain key periods, including while it is being established. Finding four windows each season when weather conditions are favourable for producing good fodder is a stress factor for the livestock farmer, as it may prove difficult to achieve. In addition, in order to preserve the quality of the fodder, most of the harvest operations must take place in the morning or

Assessment using multiple criteria

The model farm used in this study comprises 75 ha of cereals and oilseed crops, 47 ha of forage maize (11 t DM/ha), 53 ha of grassland, 121 dairy cows (1 million litres of milk sold), 3.5 annual labour units (ALUs), of which one is salaried. The introduction of lucerne (alfalfa) has been simulated with the same number of ALUs and outsourcing part of the lucerne harvesting operations (pressing-silage baling). From a financial point of view, the budget includes all production items (livestock housing, milking system, machinery…).

Plant production (fodder and grain) was characterised from a technical and economic point of view using the multiple criteria assessment software Systerre. The technical and financial calculation tool Simulbox was then used to model the workings and running of the model farm. The software produces technical output data (the balance between the animals' needs and fodder resources for example) as well as economic data (profit and loss statement, margins, production costs and costing per product: crops, milk).

the evening. Those timing constraints may conflict with other livestock farming tasks (milking cows). Such factors deter some farmers from sowing this crop.
Besides, its economic benefits must be analysed on a case by case basis. It would be interesting to examine some situations in greater depth, such as introducing it as green fodder to replace mowed grass pasture, or to complement limited production pastures.

« The introduction of Lucerne (alfalfa) induces profound structural changes. »

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