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► **To cite this version:**

Christian Huyghe, Luc Delaby, Daniele Rosellini, Fabio Veronesi. Perspectives of alfalfa in Europe. Legume Perspectives, 2014, 4, pp.5-6. hal-01455892

HAL Id: hal-01455892

<https://hal.science/hal-01455892v1>

Submitted on 27 May 2020

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LEGUME PERSPECTIVES



Alfalfa: Back to the Future

Lucerne: The first letter in the legume alphabet

The journal of the International Legume Society

Issue 4 • July 2014

Perspectives of alfalfa in Europe

by Christian HUYGHE^{1*}, Luc DELABY², Daniele ROSELLINI³ and Fabio VERONESI³

Abstract: Sustainable agriculture shall reconcile high productivity with preservation of the environment, and at the same time compete in a global market. Alfalfa can help to meet the challenges of climate change and pollution reduction, by favoring crop rotations capable of better preserving the soil and controlling weeds. The utilization of alfalfa through grazing may also reduce risks of pollution and production costs. Alfalfa will keep an important place in European agriculture, because it sustainably supports high quality dairy productions. These unique features can be further improved through technical and varietal innovation.

Key words: crop rotation, forage, grazing, *Medicago sativa*, sustainable agriculture, weed control

Stakes of the European agriculture and worldwide context

After a period when an increasing production was the only objective of agriculture, followed by a decade when the environmental issues were the main concerns, it is now well accepted that a sustainable agriculture shall reconcile high productivity with environment preservation. A highly productive agriculture must meet the food and non-food demand of the European societies and also be competitive on the world market, considering that most protein sources for supplementation of animal feed are imported, and that these products have shown large price variations in recent years.

The environmental issues are most complex to identify, because they have both merchant and non-merchant aspects, such as biodiversity preservation, and because they have different time horizons. In a short term perspective, the reduction of pollution by nitrates and pesticides is essential and prescribed by the European directive on pesticides and quality of the water resources. In a mid-term perspective, water availability and energy resources for agriculture have to be considered. In a long-term perspective, climate change will dramatically modify the conditions for agricultural activity. As a consequence, on the one hand we have to anticipate such changes, on the other hand we should reduce as much as possible the present emission of greenhouse gas (GHG), namely, CO₂ from production of agricultural inputs, CH₄ from ruminants, and N₂O from application of nitrogen fertilisers. Research and innovation are required to meet these objectives.

Potential of alfalfa in this context

Alfalfa acreage in Europe is devoted either to production of dehydrated forage, mainly in Spain, France and northern Italy, or to on-farm use of forages, mainly as hay. While the production of dehydrated forage tends to plateau or to decline due to the cost of energy for dehydration, the on-farm use of alfalfa is slightly increasing after a long period of steady decline.

In Europe, plant and animal productions tend to be separated, with specialized farms and territories. Alfalfa has the peculiarity to be inserted in grain crops rotations, and also used in animal farms. While this was considered as a downside, it appears to offer a high potential for future farming needs. In grain farms with specialized short rotations, farmers have to cope with difficulties in controlling weeds, which become highly specialized and sometimes resistant to herbicides. The insertion of perennial alfalfa in rotations with a high proportion of winter wheat has proved to be able to control well the weed flora. The results reported in Fig. 1 show that the species composition of the weed community depends on the crops, and the presence of alfalfa in rotations reduces dramatically the risk of specialization of the weed flora compared with cereal monocultures (thereby reducing the risk of generating weed flora resistant to herbicides) (2). Moreover, alfalfa in rotation with winter cereals has improved the soil structure and has provided a substantial amount of nitrogen for the two crops following alfalfa (3), thus reducing energy consumption and emission of GHG. In the same process, it prevents nitrate leaching at the rotation scale. In organic agriculture, the usefulness of alfalfa in weed control and as a source of nitrogen fertility at the rotation scale is also highly recognized in many European regions.

Production of feed proteins on the farm or in nearby cereal farms makes it possible to reduce the dependence of animal production on imported soybean feedstuff, whose prices show a high volatility. This meets the demand of farmers to be less exposed to risks. In particular for dairy cow nutrition, alfalfa (which has high protein and calcium contents) is an excellent companion of maize silage. However, even though a high protein production per unit area is a real advantage of alfalfa, the high protein solubility and the difficulty to preserve it when harvested as hay (loss of leaves) or silage (protein degradation) require innovation.

¹INRA, Scientific Directorate "Agriculture", Paris, France (christian.huyghe@lusignan.inra.fr)

²INRA, UMR Pégase, Saint-Gilles, France

³ University of Perugia, Department of Applied Biology, Perugia, Italy

Which alfalfa crops for the future European agriculture?

Because of its high agronomic potential and its ability to produce large amounts of protein per unit area, alfalfa has a role to play in European agriculture, even if some challenges have to be faced. The achievement of high biomass and protein production remains a key objective and this will be obtained mainly by improving the resistance to biotic (leaf and soil fungal diseases, nematodes) and abiotic stresses. Lodging resistance is essential in Europe to optimize spring harvest, which is the one providing the highest biomass and protein production (Fig. 2).

Persistency is not a critical issue for hay or silage production, as the present duration of most alfalfa crops (> 3 years) fits correctly in most cropping systems. It is a key issue, however, for the grazed crop, which has gained interest in the last two decades for extensive livestock systems especially in southern Europe, in order to reduce the environmental impact of intensive animal husbandry and to decrease production cost. Conventional alfalfa varieties generally do not persist under grazing. Therefore, Spanish, French and Italian research teams have started selection programs for grazing tolerant alfalfa, releasing cultivars with better survival under grazing. In the near future, European varieties specifically adapted to grazing will hopefully enter the seed market (4).

The ability to grow in mixture with a perennial grass is of interest for animal farms as it makes it possible to achieve a high biomass production without extra nitrogen fertilization, reduced weed damages, and facilitates grazing or the harvest and conservation as silage. Indeed, the water soluble carbohydrates of the associated grass will help to get low pH and improve conservation.

A major effort should be devoted to harvesting machinery. For example, mowing machines equipped with roll conditioners would make it possible to speed up the drying process, thus reducing quality losses. This is of course of major importance for hay production, but it is also valuable for ensiling with a pre-drying phase, or for production of wrapped round bales.

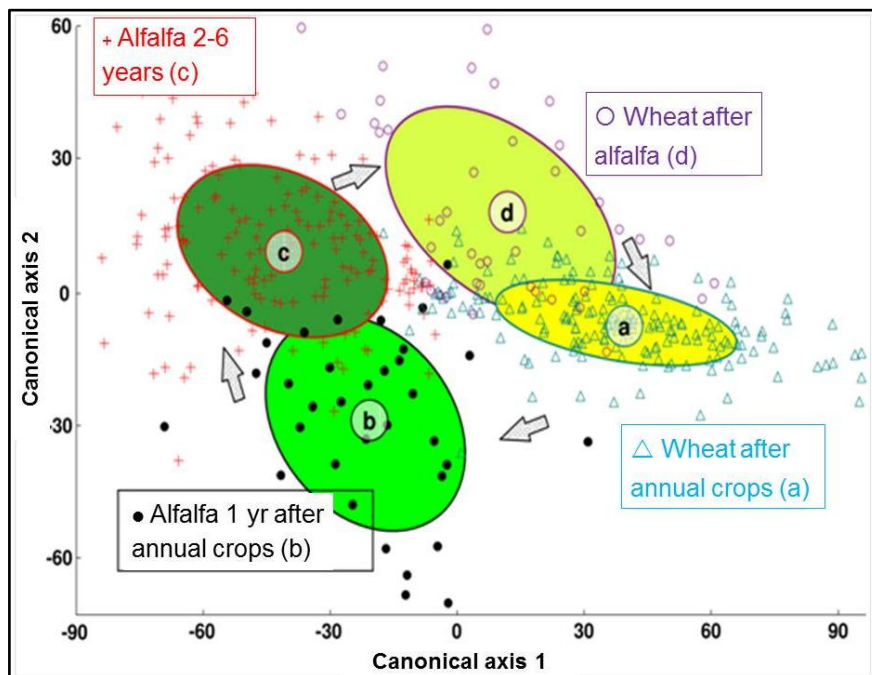


Figure 1. Canonical discriminant analysis of weed communities in 4 groups of plots (a), (b), (c) and (d) representing the four key-steps of rotations including annual cereals and alfalfa. Initial data represented the abundance of the various weed species in the crops (1)



Figure 2. A stand of the alfalfa crop at the stage of full vegetative development

On-farm barn drying is an emerging technique in some European regions, especially where high-quality products, such as protected-designation-of-origin cheeses, are produced. Alfalfa is extremely well adapted for such a production system, as it dries more quickly than other forages in the drying cells under ventilation.

In conclusion, we believe that alfalfa will keep an important place in European agriculture. Its favourable features can be further enhanced through technical and varietal innovation aimed at improved energy efficiency and reduced costs. ■

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