Overview and Prospects of the Oat Crop in Spain

Elena Prats*[1], Javier Sánchez-Martín[2], Gracia Montilla-Bascón[3],
Diego Rubiales[1], Nicolas Rispail[1]

[1]Institute for Sustainable Agriculture, CSIC, Apdo. 4084, 14080, Córdoba, Spain
[2]Institute of Plant Biology, University of Zürich, Zollikerstrasse 107, CH-8008 Zürich, Switzerland.
[3]Department of Plant Breeding and Genetics, 240 Emerson Hall, Cornell University, Ithaca, NY 14853, USA

*correspondence: elena.prats@ias.csic.es

Generalities concerning the oat crop in Spain

Oats cultivated in Spain are mainly spring types but winter-sown due to the mild winters, with a sowing date between November and December and a harvesting date between June and July. Only in some cooler areas is oat cultivated as a spring crop. In terms of cultivated area, Spain ranks second in Europe, with a stable acreage of around 500,000 ha each year (502,387 ha as mean for the period 2004-2012). In terms of grain production, Spain ranks third in Europe, producing c.a. 1 million tonnes per year (FAO, 2013). Despite these impressive figures, oat is still considered a marginal crop in Spain, receiving little attention from breeders and policy makers. Therefore, in terms of yield (average 2,000 kg/ha), Spain ranks only 23rd in Europe.

The lands dedicated to oats are mainly distributed through the centre and south of the country, with oat cultivation being low or negligible in the north and east coastal regions and in the islands (Fig.1). The regions with the greatest cultivated areas are Castilla-La Mancha, with more than 120,000 ha, followed by Castilla-León, Extremadura, and Andalucia, with an area ranging from 55,000 to 70,000 ha for each region. Oats are chiefly cultivated on small- to medium-sized farms, with a mean of 13.5 ha/farm (ESYRCE, 2009) and are grown mainly under rainfed conditions, with an average yield of 2,000 kg/ha. Only a small proportion of the cultivated area (<6%) is irrigated, increasing yield to an average of 3,200 kg/ha.

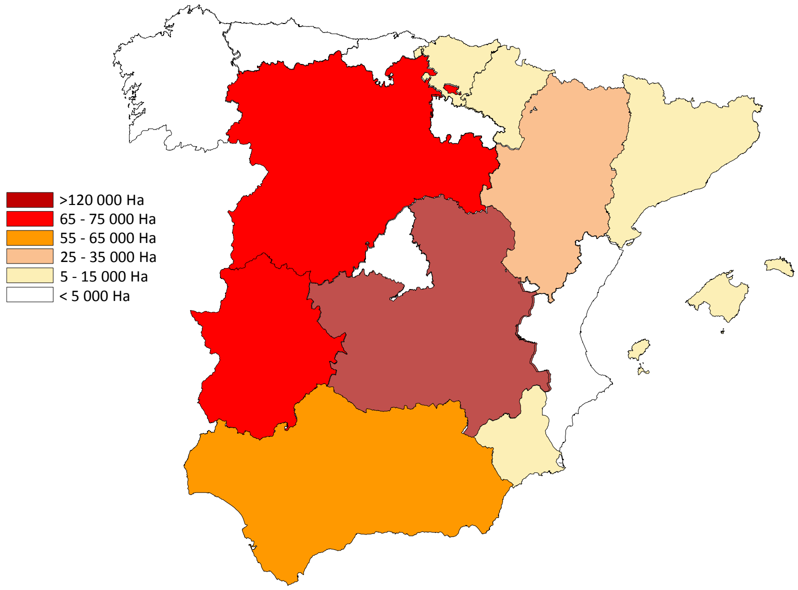

Figure 1. Distribution of the oat cultivating areas in Spain, according to the different regions.

In Spain, oats are used mainly for animal feed, primarily as grain, although straw is also used as fodder, whether fed fresh or conserved. In the 2011 season, more than 1,100,000 tonnes of grain and nearly 600,000 tons of straw were produced. In some situations, the farmers, particularly in smallholder systems, may opt for the crop to be lightly grazed before stem elongation, allowing the crop to recover and produce a further forage crop or grain for harvest. The suitability of such grazing depends on the weather, the soil conditions, and the seasonal prices. Thus, this practice is more usual in the north and when an early drought during grain filling (and hence a reduced grain yield) is predicted.

Most of the production is commercialized via small- to medium-sized cooperatives near the production areas. However, a relatively high proportion of the production remains on the farm for livestock feeding (c.a. 20%) and for seeds for the next season's sowing (c.a. 6%) (ESYRCE 2009, 2011). Despite being the third largest European oat producer, Spain still imports about 100,000 tonnes annually (mean for 2002-2012, FAO), ranking as the second largest oat importer in Europe. Most of this is used for feeding the nation's livestock or exported as part of feed and forage products. Indeed, Spain is by far the first ranked European country for exporting forage products, with more than 645,000 tonnes exported in 2011 (FAO), although this includes more than oats. Unlike the importance of oats for animal feeding in Spain, their use for human consumption is limited and no reliable statistics about this are available. Also, a small proportion of approximately 6,000 tonnes was used for biofuel production (ESYRCE, 2011).

Prospects

The important and stable oat cultivation area in Spain over the last 50 years shows that the crop is very much a part of the farmers´ agenda and that farmers know the essentials for the management of the crop. Also, the fact that 100,000 tons are imported annually reinforces the internal demand and the prospects for further developing the crop in the country. Farmers see oat as a means to obtain some economic benefit under harsh cultivation conditions, because of its adaptability to a wide range of soil types and because, on marginal soils, oats outperform other small-grain cereals (Stevens *et al*., 2004). However, famers tend to rely on higher gross margin cereal crops such as wheat or barley, that have similar or higher prices (i.e., 166 and 143 €/ton on average for wheat and barley, compared to 141 €/ton for oat, for the 2001-2011 period, ESYRCE) and produce higher yields (3,200 for wheat and 2,900 for barley under rainfed conditions, ESYRCE, 2011), factors that make these crops more attractive to farmers.

Average oat yields in Spain are low not only as a result of the practice of dedicating the crop to poorer soils, but also as a result of the low level of attention being paid to the crop. This has resulted in a relatively low yearly gain in yield derived from the genetic improvement of cultivars and of adjustments in crop management, unlike in wheat or barley, crops for which significant breeding investments have been made. Even taking into account the differences in the climatic conditions compared to northern countries, there is still a lot of potential to increase oat yield by improving the crop's adaptation to southern conditions. When comparing the yield with other European countries, either with warm, temperate moist climates (e.g., France) or cool, temperate moist climates (e.g., Ireland) (Intergovernmental Panel on Climate Change, 2006), not in absolute terms, but with respect to the gain in yield over the last 50 years, we can see large differences in the slopes of the regression lines (e.g., an annual increase of 112 kg for Ireland, 51 for France, but only 22 for Spain), showing the much lower breeding and agronomic efforts for this crop in Spain compared with other European countries (Fig. 2).

The relatively lower yield may be due in part to the limited adaptation of the varieties used, which are usually spring varieties bred in northern countries and used here as a winter crop. Therefore, there is a need to study the adaptation of these spring varieties to Mediterranean agroclimatic conditions and also to implement specific breeding programs based on the particular requirements of the southern Mediterranean areas (Sánchez-Martín *et al*., 2014). One of the challenges to be tackled is the low adaptation of oats to high temperatures and drought, common to most Mediterranean growing areas. Although oats have vigourous root systems that exploit the soil well, giving high soil nutrient use efficiency, their transpiration rates and, hence, water requirements, are higher than that of other small grain cereals (Ehlers, 1989). Thus, oats are especially susceptible to grain abortion caused by drought, which shows as empty white spikelets in the crop. Therefore, there is a need for improved oats lines with higher yields under the drier Mediterranean conditions.

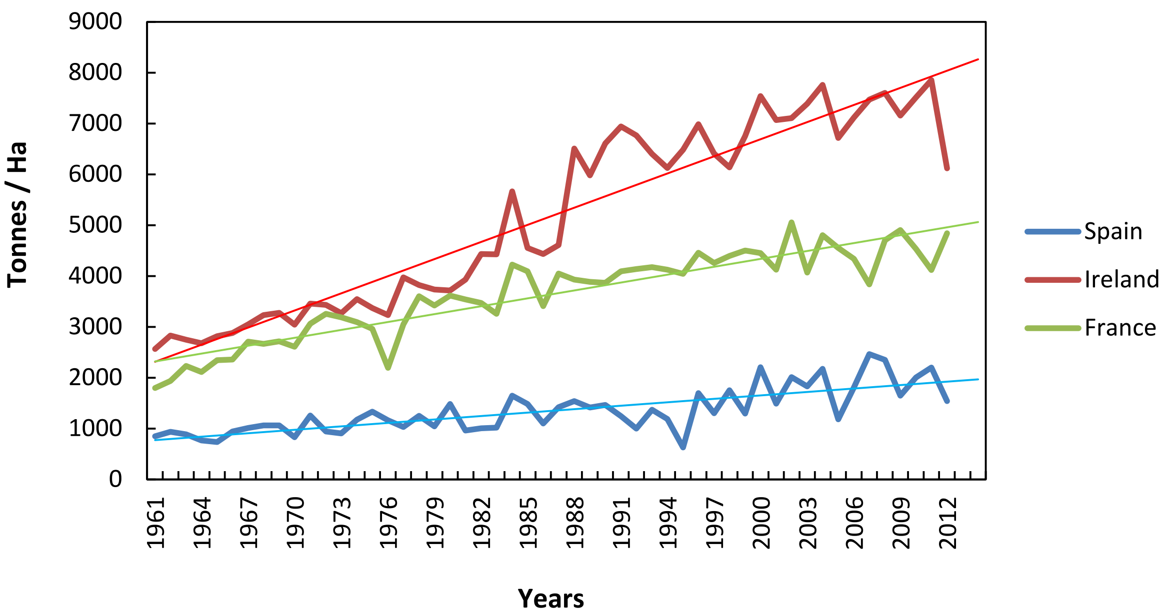

Figure 2. Average yield of oat in Spain compared to Ireland and France. The slope of each regression line indicates the yearly gain.

The fact that the farmer associates oats with being a low input crop also highlights another important desired trait for their cultivation, including resistance to diseases, since they are the main causes of yield instability and additional expenses for chemical treatments. Biotrophic fungi, such as the rusts and powdery mildew, cause important losses in oat. Particularly in the Mediterranean Basin, rust populations are more virulent than in the centre and north of Europe (Herrmann and Roderick, 1996). Because their mechanisms of spread are very efficient, crop management practices are inefficient for their control. Thus, breeding for resistance is the most effective, economical, and environmentally friendly means to control rust (Stevens *et al*., 2004). However, the resistance obtained is often overcome by emerging pathogenic races. This is mainly due to the inappropriate use of resistance sources; i.e., those of a monogenic nature. Thus, it is necessary to identify novel sources of resistance that show durable resistance over time and in different environments (Sánchez-Martín *et al*., 2012). Both drought tolerance and durable resistance to pathogens are complex traits and/or have low heritability. As a consequence, the selection of improved oat cultivars based solely on yield is insufficient and needs to be complemented with a sound understanding of innate tolerance mechanisms on which breeding programs may be based. (Sánchez-Martín *et al*., 2011).

Another factor that may limit new interest in the crop is the reduced marketing activity compared with other crops. As stated above, farmers save up to 25% of the seeds for use as feed on the farm and for the sowing of the next season's crop. This reduces the certified seed market, limiting, in part, the breeding efforts. On the other hand, the crop may benefit from an increase in information and marketing activity with respect to the advantages that the cultivation of quality oats for human consumption may provide (i.e., low oil percentage or high beta glucan). Increases in the area cultivated for human consumption would contribute to increased prices, making the crop more attractive to the farmers, as may happen in the UK, in which about half of the oat crop is milled and used for human consumption; e.g., in breakfast cereals, cheese biscuits, and haggis.

Overall, oat in Spain is a well-established crop but there is a wide margin for its improvement. This effort should focus on the breeding of the crop for our specific agroclimatic conditions and the farmer´s needs, and creating a better commercialisation chain, leading the oats to become a high yielding and economically stronger crop.

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