EARLY RESULTS OF THE EFFECT OF TWO VARYING CELTIC PIG STOCKING DENSITIES ON IBERO-ATLANTIC OAKWOODS (A CORUÑA, SPAIN)

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Abstract

The effect of 2 different pig stocking rates (4 and 8 animals per ha) in a silvopastoral system (SPS) of oak - Celtic pig was evaluated in terms of pig growth and morphometric variables after 7½ months in the forest and the incidence of their manure on the quality of water from fountains and springs. Acorn production was also measured at the trial site as well as at 7 other locations in Galicia. By the end of the fattening period, the pigs had doubled their weight, although the increase was greater in those reared at the high stocking rate (8 pigs/ha). The effect on springs and fountains reflects an increase in physiochemical and microbiological parameters, although low rainfall during the assay year may have altered the results compared to a standard year. Total acorn production varied between 503 and 1,848 kg dry weight (p.s.) per hectare and maximum production rate is found in the second half of September.

Keywords: oakwoods, environment, Celtic pig, carcass, acorns, diffuse contamination

Introduction

Silvopastoral systems (SPS) with Celtic pigs in Galician chestnut groves and oak groves have demonstrated their economic viability and an increasing number of farms have been set up with such a system. Information about this type of system, its effect on the immediate environment, stocking capacity and quality of the carcasses, meat and fat of animals raised on such SPS is scarce. A manual on the Celtic pig [*porco celta*] breed has been published (Lorenzo and Fernández 2013), as has some work on the effects on the environment (Rigueiro et al. 2012).

As a way of understanding the effect of pigs on these systems in Atlantic Galicia more precisely, a trial was set up in order to compare 2 stocking rates. This paper presents the first results about production data and the pigs' morphometric measurements, the effects on spring water and the production of fruit.

Materials and methods

The experimental trial using pigs is located in Rois (C) and is installed in a communal oak forest (*Quercus robur*) with a tree density of 460 per ha, of which 70% are oaks and the rest pines, eucalyptus and other species, with a mean diameter (DAP) of 25 cm and mean height of 16 m. For the breed, we used Celtic pig [*porco celta*] in an extensive farming regime, with stocking densities of 0, 4 and 8 pigs/ha and 3 repetitions. The herds (4 animals per type of treatment plus the repetition), were reared on the farm, fed *ad libitum* with rearing fodder after weaning up to a minimum weight of 60-80 kg (4-6 months of age), at which point they were set loose on the plots in early Spring (April 14, 2017). Females and previously castrated males were randomly distributed on the plots. Fattening in the field was based on wild vegetation and fruits (in the autumn), with 2 kg of feed/head/day until the pigs were removed. The animals were weighed at the outset and at 12 months of age (November 29), after 7½ months roaming free. After that,

the animals were slaughtered and their morphometric carcass measurements taken (based on Mayoral 1996, according to Lorenzo and Fernández, 2013). A methodological guide was drawn up for the location of sampling points, sampling and measuring (CIF de Lourizán et al. 2016; Alejano et al. 2011).

There exist several water springs, wells and tanks in the same area downstream from the plots from which samples were collected before and after the pigs' presence. The parameters for analysis were both physiochemical (conductivity, pH, turbidity, ammonium, nitrite, nitrate) and microbiological (total coliforms, *Escherichia coli* and fecal enterococci), determined using official methods.

Acorn production was measured on the experimental plot (Rois, C) and at seven other sites distributed throughout Galicia, NW Spain (Siador, A Lama, Cotobade, Lourizán, PO, A Lastra, Estornin, LU, Xurés, OR). In each locality, 6 x 0.5 m^2 circular collectors (3 static and 3 mobile) were installed (only data from the static units are provided), in a 10 x 10 m square area. Collection took place every fortnight and the acorns were dried in a 60°C oven up to a constant weight.

Results

The pigs went onto the plots with an average weight of 82 kg per head (aged 5-6 months) and at the age of 12 months, they had reached an average weight of 159 kg, thus displaying a growth rate of almost 100% compared to the initial weight. The stocking rate has had a remarkable effect - the initial average weight was 80 and 83 kg (for stocking rates of 4 and 8 pigs/ha respectively) and reached end weights of 140 and 169 kg/pig respectively, which indicates a significant difference between regimes of 29 kg in favor of the higher stocking proportion (Figure 1). Carcass yields grew by over 80%, with a significant difference between the animals in the low stocking rate (84%) and those in the high stocking rate (81%). We did not observe any relationship between carcass weight and fat thickness, although the animals at the high stocking rate had greater fat thickness than those at the low stocking rate. The thickness of dorsal fat or bacon at the 4 measuring points (EDT1, EDT2, EDT3, EDT4) was seen to be high (Table 1), a characteristic feature of the breed. For the high stocking rate group, a strong positive correlation is observed between the end live weight and the perimeter and length of the ankle diameter and compactness index (head-to-tail weight / length ratio, CL). For other parameters, no significant differences were found between stocking rates (Table 1).

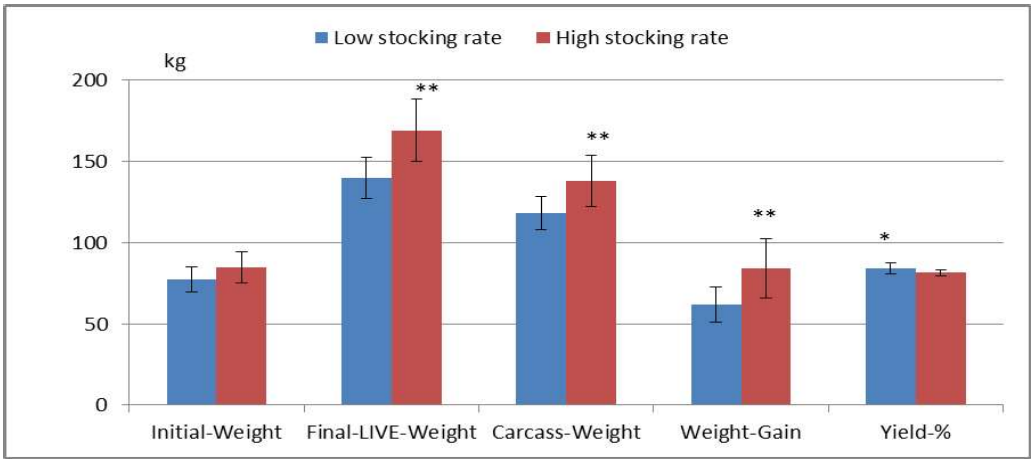

Figure 1: Pig weights (initial, end live, carcass and gain, in kg) and yield (carcass/end live weight ratio in %) on different plots and treatment regimes in Rois. t-test probability, no paired samples (n = 17), two-tailed distribution, two samples assuming unequal variance (** p≤0.05; * p≤0.1).

Table 1: Average morphometric measurements of carcasses. ETD1-EDT4, thickness of back fat or bacon, in mm. LL, leg length; A, ankle diameter; HmL, ham length; PH, perimeter ham; CL, head-to-tail [canal] length; HnL, hand length, all in cm, according to Mayoral (1994) in Lorenzo and Fernández (2013). ([1] semi-extensive system, De la Roza et al. inéd.; [2] extensive system, De la Roza et al. inéd.; [3] Argamentería et al. 2012; [4]Lorenzo and Fernández 2013; *significant difference according to the authors).

	ETD1	ETD2	ETD3	ETD4	LL	A	HmL	PH	CL	HnL
Low stocking Rois	57.2 +12.9	41.7 +9.7	53.9 +11.4	39.0 +10.5	73.2 +1.6	16.4 +0.8	46.1 +1.2	73.3 +4.2	91.8 +2.4	48.0 +5.3
High stocking Rois	64.5 +13.0	44.8 +4.5	55.3 +3.9	43.4 +5.0	73.9 +2.5	16.6 +1.8	46.3 +1.9	72.6 +4.3	93.0 +3.7	43.9 +4.1
Gochu Astur-Celta[1]		18.1*		19.9*	69.6	23.6*	43.3	66.7	93.5	41.1
Gochu Astur-Celta[2]		35.4*		40.9*	70.2	25.3*	46.6	77.6	95.7	42.0
Gochu Astur-Celta[3]		41.1 +1.2		53.5 +1.3	68.9 +6.8	22.5 +2.9	43.7 +4.4	83.7 +8.83	97.1 +8.5	39.7 +4.24
Celtic pig[4]	56.0	40.3	46.7	40.5	72.0		44.9	76.1	91.6	41.1

The soils at the experimental site have developed on granite rock and produced clearly sandy textures (>80% of total sand). To analyze water affectation due to pig manure, it should be taken into account that 2017 was one of the driest years on record (R = ±1,000 mm), when the average in the area stands at around 1,700 mm. Towards the end of the fattening period, an increase in some physiochemical parameters can be observed, such as turbidity and conductivity, possibly related to low rainfall. With regard to microbiological parameters, an increase in total coliforms is observed at several of the sampling points -including those at Sources 1a, 1b and 1c, which are not influenced by the test plots- (Figure 2), while a significant increase is observed for *Escherichia coli* and intestinal enterococci at the Source3 sampling point, which is located very close to the edge of one of the plots and thus seems to indicate a certain degree of affectation. The increase in fecal parameters is significant, especially at the Source3 sampling point, because although total coliforms may have increased as a result of concentration due to low rainfall, that does not explain such a remarkable increase in fecal parameters, which were absent before the pigs' arrival, measured in both June 2016 and March 2017. The sustained increase over time in the number of total coliform colonies forming units at distribution Source2 may be related to the decrease in rainfall in 2017.

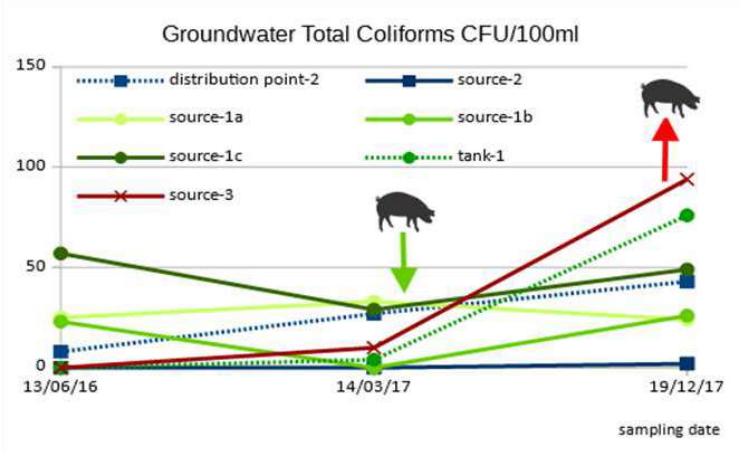

Figure 2: Evolution of total coliforms in springs, tanks and reservoirs, prior to and during the pig fattening period. The green arrow denotes the pigs' arrival on the plots and the red arrow their departure.

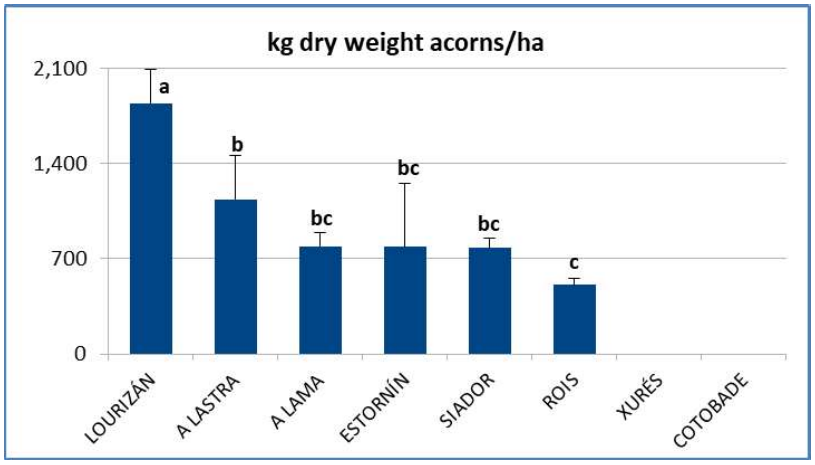

Figure 3: Aggregate dry weight kg/ha during the 2017 campaign at the 8 trial locations. The error bars represent the standard deviation for the mean of the 3 static baskets. Different letters indicate significant differences between localities for p <0.05. Locality factor (F = 9.80, Prob> F 0.0006).

In 2016, the production of acorns was null in the 8 sampling plots, while in 2017 all the locations bore acorns except in 2 (Cotobade, Xurés). The production, with significant differences between localities, varies between 507 in Rois (C) and 1,848 kg p.s./ha in Lourizán (PO), both localities correspond to those of lower height, while in A Lastra, 850 m high, the production was 1,130 kg p.s./ha (Figure 3), but no relationship was observed with height. In general, the highest production of acorns is recorded in the second half of September, although the broadest period of fruition occurs in the plots of height, Estornín and A Lastra (Figure 4). In Siador, the largest acorns were collected, both in length and width, as well as the higher relationship between the them (ratio = 1.7).

Discussion

The data obtained corresponds to a single fattening cycle. The animals at the high stocking rate (8) grew more than the ones at the low stocking rate (4) and lumbar bacon thickness was slightly lower in the latter. Carcass yield was higher at the low stocking rate, compared to those in the high stocking rate group or in other native Iberian and European breeds (De la Roza et al. 2012; Lorenzo and Fernández 2013). Fat thickness in the Rois pigs is clearly greater than for Goucho Astur-Celtic pigs in an extensive regime but similar to that found in semi-extensive farming regimes (Table 1, De la Roza et al. 2017; Argamentería et al. 2012). The results in terms of weights may seem contradictory and may be influenced by the size of the subplots (the plots with the high stocking rate measure 0.5 ha versus the 1 ha of the low stocking rate group) and by the distances the pigs travel within them, so we intend to follow up this matter using GPS this year. The next fattening cycles will confirm these trends.
The impact on waters has probably been affected by the irregular rainfall, so although there is an increase in several parameters at the end of the pigs' fattening period, which is apparently logical, we cannot determine what influence on that the scant rainfall, responsible for the low flow levels in water springs and sources, has played.

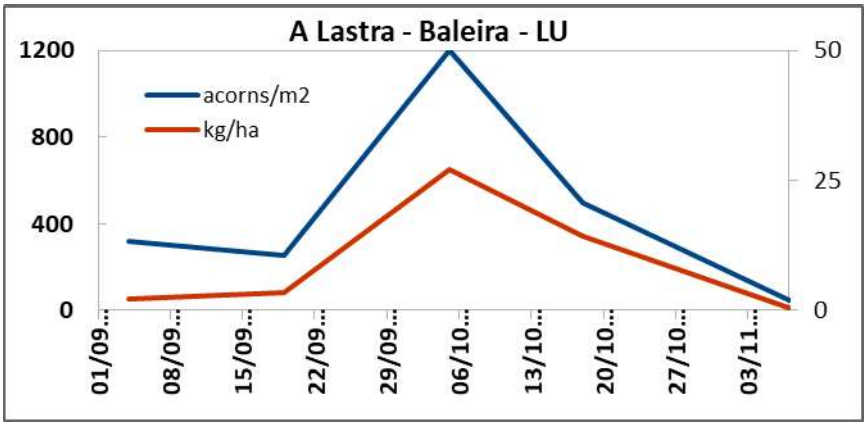

Figure 4: Acorn falling evolution over time in A Lastra (O Cadavo, Lugo) expressed as number of acorns per m2 (blue-right) and d.w. per ha in kg (red-left) in the static collectors. The X axis represents the sampling dates (2017).

Acorn production corresponds to the significant year-on-year variation in oak (*Quercus* spp.) fruit bearing (Johnson et al. 2009), since they bore no fruit in 2016 but they did in 2017) (Figure 3). The values obtained are in general notably higher than in France (Caignard et al. 2017) or in oak or cork oak (*Quercus ilex, Q. suber*) stands in southern Spain, although oak acorns are wider and shorter than those of Ilex or cork oak (Alejano et al. 2011). A comparison of Galician and Polish acorns reveals that the Spanish acorn is bigger and thinner but somewhat shorter (weigth: 3.80 d.w. g; width: 1.54 cm; length: 2.32 cm;) than those described by Luczaj et al. (2014) (weigth: 3.15 d.w. g; width: 1.48 cm; length: 2.71 cm) for Poland, in both cases with a large variability.

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