ANALYSIS OF MANAGEMENT TECHNIQUES ON PRODUCTIVITY INDICATORS USING THE bdcuni SPANISH DATABASE

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ABSTRACT

The objective of this work was to study the effect of the size of the farm (<600 does, 600-1,000 does and >1,000 does), the geographic area (north, central, and Mediterranean area), the batch management (one or more batches), and the season (hot and mild season) on technical trait production results of rabbitries, using data from the Spanish rabbit database "**bdcuni"**. Technical data from a total of 46 farms were used with 947 batches recorded. Size of the farm had an effect (P<0.05) only on the amount of kg produced per kindling, being higher on farms with 600 to 1,000 does than on farms with less than 600 does. Batch management was only related with the market liveweight, being the heaviest on farms managed using one batch. No effects of season (P>0.05) were observed on real fertility, number of kindlings per female and year, and mortality rates. Effects of season of insemination on liveweight for sale, number of kits born alive, number of kits weaned, number of kits produced, and amount of kg produced per female and year, per insemination, and per kindling were found (P<0.05) with higher values for inseminations in hot compared to the season. Geographic area had an effect (P<0.05) on several production traits, mostly with differences between the north compared to central and Mediterranean areas.

Keywords: Production, rabbits, technical management.

INTRODUCTION

Rabbit meat production represents 0.6% of total meat production in the world. The European Union is the second largest producing region (Asia being the largest)(FAO, 2010). Spain is the second largest rabbit producing country in the European Union (FAO, 2009). This industry represents 1.4% of total livestock production in Spain, and 0.5% of the agricultural production in 2010. The rabbit sector in Spain does not have a high turnover, with 187 million euros in 2010 (MARM, 2010), but it is an important economic activity in rural areas.

The Spanish rabbit sector is very heterogeneous. Other livestock activities have integrated production systems, but the Spanish rabbit sector is quite self-reliant or isolated. The 86.0% farmers are self-employed workers (MARM, 2009). The Spanish rabbit sector is a family-based business with 24.4% of farms having less than 100 does and 62.7% with less than 400 does in 2008 (MARM, 2009). These particular characteristics of the sector are the cause of very heterogeneous management practices.

The aim of this work was to study the effect of different management techniques on productive trait level results.

MATERIALS AND METHODS

Technical data

The technical data belonged to 947 batches recorded between 2006 and 2011 from 46 rabbit farms included in the **bdcuni** Spanish database.

The 37.0% of the batches belonged to farms with less than 600 does, 29.0% had between 600 and 1,000 does, and 34.0% had more than 1,000 does. The 62.8% of the batches were from farms with 1 batch management, and 37.2% from farms with more than 1 batch management. The 43.9% of the farms were located in the north area, 46.7% of the batches were from the central area, and 9.4% were from farms located at the Mediterranean area. The 33.2% of the batches were inseminated during the hot season (May, June, July and August), and 66.8% during the mild season (any month not included in the hot season).

Technical data recorded per batch were date of insemination, number of females (F), inseminations (I), positive palpations (PP), number of kindlings (K), number of kits born alive (BA), stillbirths (SB), weaned kits (W), kits sold at one day old (S1), sold to the slaughterhouse (SS), kg sold to the slaughterhouse (KgSS), sold at retail (SR), self-consumption (SC), sold to other farms (SOF), and kept in the farm for the self-replacement (SRP). Technical indexes per batch were calculated as:

RF: Real fertility = (K/F) x 100
KI: Kindling interval = (α+β1 x γ+β2 x γ2+β3 x γ3); where α=gestation days+ days between kindling and insemination; γ=100-RF or γ=100-PP, for 1 batch or more than one batch, respectively; and β1, β2, β3 are parameters that depend on number of batches and numbers of days between kindling and insemination.
KFY: Kindlings per female and year = 365/KI
LM: Lactation mortality = [((BA-S1)-W)/(BA-S1)] x 100
FM: Fattening mortality = [(W-PR)/W] x 100; where PR: rabbits produced = SS+SR+SOF+SC+SRP
TM: Total mortality = [((BA-S1)-PR)/(BA-S1)] x 100
MWS: Liveweight for sale = KgSS/SS
BAFY: Kits born alive per female and year = KFY x BA/K
WFY: Weaned kits per female and year = KFY x W/K
PRFY: Number of rabbits produced per female and year = KFY x PR/K
KgPRFY: Amount of kg produced per female and year = PRFY x MWS
BAK: Kits born alive per kindling = BA/K
WK: Weaned kits per kindling = W/K
PRK: Number of rabbits produced per kindling = PR/K
KgPRK: Amount of kg produced per kindling = PRK x MWS
BAI: Kits born alive per insemination = BA/I
WI: Weaned kits per insemination = W/I
PRI: Number of rabbits produced per insemination = PR/I
KgPRI: Amount of kg produced per insemination = PRI x MWS

Statistical analysis

Least squares analyses were performed using the mixed model procedure of SAS (SAS, Inst., Inc., Cary, NC). The model included farm as a random effect, and the farm size (3 levels: less than 600 reproductive females, between 600 and 1,000 and more than 1,000), the batch management (1 batch or more than 1 batch), the geographic area (3 levels: north, central, and Mediterranean area), and the season (2 levels: hot and mild) as fixed effects. The WFY, PRFY and KgPRFY were also analysed including BAFY as a covariate, WK, PRK and KgPRK included BAK as a covariate, and WI, PRI and KgPRI included BAI as a covariate.

Principal component analyses (PCA's) between indexes were carried out and data were projected on the axes to test differences due to farm size, batch management, geographic area and season using Statgraphics Plus 5.1. The PCA's with the residuals of the indexes were also carried out in order to observe the relationships between the indexes and Pearson correlation coefficients of the residuals that were obtained.

RESULTS AND DISCUSSION

Size of the farm had only a significant effect on KgPRK, being higher in size 2 (16.5 kg) than in size 1 (14.7 kg; results not shown). No differences in KgPRI and KgPRFY were found (P-values were between 0.05 and 0.10). Batch management had only an effect on MWS with heavier weights on farms that used the 1 batch management system than on farms with more than 1 batch.

The results of the season and geographic area effects are presented in Table 1. No effect of season on RF, KI and KFY was observed (P>0.05). These results agree with those reported by Yamani *et al.* (1991) and Rodriguez de Lara and Fallas (1999), who did not observe any effects of season on conception rate. On the other hand, Marai *et al.* (2006) observed an effect of season on kindling and conception rate with lower values for summer, but without an effect of season on kindling interval. The effect of season was not found (P>0.05) on mortality rates (LM, FM, TM). In agreement, Marai *et al.* (2006) did not find differences on pre-weaning mortality due to the season effect.

The MWS was heavier in batches that involved inseminations in hot compared to inseminations in the mild season. These results differ from the findings obtained by Pla et al. (1994) who used climatic chambers and found the lightest liveweights for rabbits reared at high temperatures (30ºC), which are typical of temperatures reached in most regions of the Iberian Peninsula during the summer season (mainly in July and August; MARM, 2011). The effect of season on number of kits born alive, weaned, produced and kg produced per females and year, per insemination and per kindling was found (P<0.05). Technical results with date of insemination during the hot season showed higher values than results for date of insemination during the mild season. The differences observed in weaned, produced, and kg produced were mainly due to the number of kits born alive, because differences due to the season disappeared when including born alive in the model as a covariate (results not shown).

Geographic area had effect (P<0.05) on several production traits. Most differences were found comparing the north with the central and Mediterranean areas. RF and KFY had lower values and KI higher values in the north area. FM and TM were higher in the north area than in the central area. The heaviest MWS values were observed in the north area and the lightest in the Mediterranean area. The number of kits weaned, produced and amount of kg produced per female and year and per insemination, and rabbits produced per kindling had lower values in the north than in the central area.

Table 1: Mean and coefficient of variation (CV) of the indexes and least square means (and standard errors) for season and geographic area.

Technical results	Mean	CV	Season		Geographic area		
			Hot	Mild	North	Mediterranean	Central
RF	78.6	0.11	81(1.2)	80(1.3)	74^{a}(1.5)	85^{b}(3.0)	81^{b}(1.7)
KI	53.8	0.12	53(1.2)	54(1.2)	58^{b}(1.4)	51^{a}(2.8)	51^{a}(1.6)
KFY	6.87	0.10	6.9(0.12)	6.9(0.12)	6.4^{a}(0.14)	7.3^{b} (0.28)	7.1^{b} (0.16)
LM	12.8	0.43	12.9(0.82)	13.0(0.84)	14.6(0.99)	12(2.0)	12(1.1)
FM	8.02	0.98	8(1.6)	8(1.6)	13^{b}(1.9)	8^{ab}(3.8)	4^{a}(2.2)
TM	19.7	0.46	20(1.7)	20(1.7)	26^{b}(2.0)	19^{ab}(4.0)	15.4^{a}(2.3)
MWS(g)	2158	0.06	2123^{b}(18)	2089^{a}(19)	2179^{c}(22)	2004^{a}(44)	2135^{b}(25)
BAFY	65.2	0.13	66^{b}(1.4)	65^{a}(1.5)	61^{a}(1.7)	68^{b}(3.4)	67^{b}(2.0)
WFY	57.0	0.15	58^{b}(1.5)	56^{a}(1.5)	52.0^{a}(1.8)	60^{b}(3.6)	59^{b}(2.1)
PRFY	52.7	0.19	53^{b}(1.8)	52^{a}(1.8)	45.7^{a}(2.1)	55^{b}(4.2)	57^{b}(2.4)
KgPRFY	114	0.20	112^{b}(3.9)	108^{a}(4.0)	99.3^{a}(4.8)	110^{b}(9.4)	121^{b}(5.4)
BAK	9.48	0.07	9.51^{b}(0.091)	9.34^{a}(0.094)	9.5(0.11)	9.4(0.22)	9.4(0.12)
WK	8.30	0.09	8.3^{b}(0.12)	8.1^{a}(0.12)	8.1(0.14)	8.2(0.29)	8.3(0.16)
PRK	7.62	0.14	7.6^{b}(0.19)	7.5^{a}(0.19)	7.1^{a}(0.23)	7.6^{ab}(0.45)	8.0^{b}(0.26)
KgPRK	16.5	0.15	16.1^{b}(0.45)	15.6^{a}(0.45)	15.4(0.54)	15(1.0)	17.0(0.61)
BAI	7.34	0.14	7.4^{b}(0.15)	7.2^{a}(0.15)	7.0(0.18)	7.4(0.35)	7.5(0.20)
WI	6.42	0.16	6.5^{b}(0.15)	6.3^{a}(0.16)	6.0^{a}(0.19)	6.5^{ab}(0.37)	6.6^{b}(0.21)
PRI	5.93	0.19	5.9^{b}(0.19)	5.8^{a}(0.19)	5.3^{a}(0.23)	6.0^{ab}(0.45)	6.3^{b}(0.26)
KgPRI	12.8	0.21	12.6^{b}(0.44)	12.1^{a}(0.45)	11.4^{a}(0.53)	12^{ab}(1.1)	13.6^{b}(0.60)

^{a,b,c}Mean values in the same row and effect with different superscripts differ (P<0.05). RF: real fertility; KI: kindling interval; KFY: kindlings per female and year; LM: lactation mortality; FM: fattening mortality; MWS: liveweight for sale; BAFY, WFY, PRFY and KgPRFY: born alive, weaned, produced and kg produced per female and year, respectively ; BAK, WK, PRK, KgPRK: born alive, weaned, produced and kg produced per kindling; BAI, WI, PRI, KgPRI: born alive, weaned, produced and kg produced per insemination, respectively.

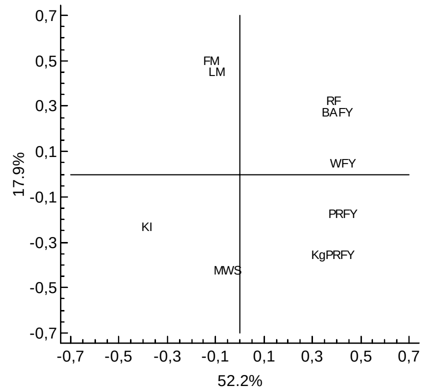

Figure 1: Projection of the residuals of some indexes on the plane defined by the two principal components and variation (in the axes) explained by the component. RF: real fertility; KI: kindling interval; LM: lactation mortality; FM: fattening mortality; MWS: liveweight for sale; BAFY, WFY, PRFY and KgPRFY: born alive, weaned, produced and kg produced per female and year, respectively.

The projection of the indexes and data from PCA did not show any clear classification patterns based on the number of batches, geographical area, size of the farm, or season of insemination of the batch. Figure 1 shows the PCA for the residuals of some of the indexes analysed. The first principal component (PC) explained 52.2% of the variation and was defined by the WFY. The second PC explained 17.9% of the variation and was mainly defined by LM, FM, and MWS, which lay opposite on the axis. This suggests that most of the variability observed in the residuals was due to the number of weaned kits per female and year, the mortalities and the weight at slaughter. According to the correlation coefficients (Table 2), indexes per insemination and indexes per female and year were highly or moderately related with the reproductive efficiency (lower than -0.53 or higher than 0.53). When indexes were applied on a per kindling basis, they were not correlated with the reproductive efficiency indexes because the former were calculated based on pregnant females. The WFY, WI and WK had low to moderate correlation with LM (between -0.33 and -0.58). The correlation of PRFY, PRI and PRK with FM was moderate (between -0.41 and -0.56).

Table 2: Pearson correlation coefficients between the residuals of the technical trait indexes.

	RF	KFY	KI	LM	FM	TM	MWS	BAFY	WFY	PRFY	KgPRFY	BAI	WI	PRI	KgPRI	BAK	WK	PRK
KFY	0.96	1																
KI	-0.97	-0.96	1															
LM	0.04	0.04	-0.03	1														
FM	-0.08	-0.07	0.09	0.02	1													
TM	-0.02	-0.02	0.03	0.71	0.71	1												
MWS	-0.13	-0.13	0.14	0.01	-0.11	-0.07	1											
BAFY	0.72	0.75	-0.72	0.15	0.00	0.10	-0.21	1										
WFY	0.66	0.68	-0.66	-0.38	-0.02	-0.28	-0.20	0.85	1									
PRFY	0.60	0.63	-0.61	-0.35	-0.45	-0.56	-0.12	0.75	0.89	1								
KgPRFY	0.53	0.55	-0.53	-0.33	-0.46	-0.56	0.33	0.63	0.76	0.89	1							
BAI	0.81	0.81	-0.81	0.14	-0.02	0.09	-0.20	0.98	0.84	0.74	0.62	1						
WI	0.76	0.76	-0.76	-0.33	-0.02	-0.24	-0.19	0.86	0.98	0.87	0.75	0.88	1					
PRI	0.71	0.71	-0.71	-0.31	-0.41	-0.50	-0.13	0.78	0.90	0.98	0.88	0.80	0.91	1				
KgPRI	0.64	0.64	-0.64	-0.30	-0.42	-0.50	0.28	0.67	0.79	0.89	0.98	0.70	0.81	0.91	1			
BAK	0.07	0.06	-0.07	0.18	0.07	0.17	-0.19	0.71	0.55	0.46	0.36	0.61	0.49	0.42	0.33	1		
WK	0.03	0.03	-0.04	-0.58	0.04	-0.38	-0.16	0.48	0.74	0.64	0.54	0.40	0.65	0.57	0.49	0.70	1	
PRK	0.07	0.07	-0.08	-0.49	-0.56	-0.74	-0.07	0.40	0.62	0.80	0.73	0.34	0.55	0.72	0.66	0.53	0.80	1
KgPRK	0.01	0.00	-0.01	-0.44	-0.54	-0.69	0.46	0.25	0.45	0.65	0.82	0.21	0.40	0.58	0.75	0.37	0.63	0.85

RF: real fertility; KFY: kindlings per female and year; KI: kindling interval; LM: lactation mortality; FM: fattening mortality; MWS: liveweight for sale; BAFY, WFY, PRFY and KgPRFY: born alive, weaned, produced and kg produced per female and year, respectively. BAI, WI, PRI and KgPRI: born alive, weaned, produced and kg produced per insemination, respectively; BAK, WK, PRK and KgPRK: born alive, weaned, produced and kg produced per kindling, respectively.

CONCLUSIONS

Size of the farm and batch management had an influence on a few traits. Season of insemination and geographic area of the farm had effects for most traits. This database could be very worthwhile; however, these results should be considered as preliminary. Further analyses involving a larger number of farms are necessary.

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