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Deroua a new synthetic breed for the improvement of sheep production in Morocco

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Abstract. Composite breeds are known for their capacity to combine traits of interest for increasing productivity in sheep production. They could also meet the needs of the breeders who want to simplify and facilitate herd management and animal self-renewal. The Deroua sheep is a new composite breed obtained by a continuous crossbreeding plan including two main indigenous Moroccan breeds: the Dman a prolific breed with 50% of genes and Boujaad a rustic breed with 50% of genes. The present study described the performance of 395 ewes and 976 lambs of the new breed collected between 2011 and early 2018. Fixed factors that influence significantly those performances were defined using linear models. Estimated parameters for Deroua new breed ewe and lamb were comparable to other good breeds, e.g. 1.61 lambs and 20.5 kg respectively for the prolificacy and the litter size at weaning per lambing. The results showed that all traits and especially growth performance were significantly influenced by the studied fixed factors (ewe age, sex and birth mode). Performance could be increased by selection with appropriate criteria. The new breed should be reared under actual breeding conditions to record performance in the field. However, it was already concluded that the new breed would constitute a valuable resource for improving sheep productivity in Morocco under suitable breeding conditions.

Keywords. Sheep breeding – Synthetic breeds – Deroua – Prolificacy – Morocco.

Deroua, une nouvelle race synthétique pour le développement de l'élevage ovin au Maroc

***Résumé**. Les races synthétiques sont connues pour leurs aptitudes à combiner des traits complémentaires pour améliorer la productivité et l'efficience de l'élevage ovin. Elles permettent également de satisfaire les besoins des éleveurs désirant de simplifier la conduite de leurs troupeaux et d'assurer un auto-renouvellement facile des animaux. La race Deroua est une nouvelle race composite obtenue par un plan de croisement continu entre deux races locales marocaines : La Dman, une race connue pour sa prolificité et ses performances de reproduction élevées et la Boujaad, une race rustique ayant des performances de croissance améliorées, avec 50% des gènes chacune. La présente étude décrit les performances de reproduction de 395 brebis et de croissance pré-sevrage de 976 agneaux Deroua et les effets des facteurs environnementaux en utilisant des modèles linéaires pour les données collectées entre 2011 et 2018. Les paramètres estimés montrent des performances très satisfaisantes avec comme exemple une prolificité et un poids de portée au sevrage moyens de 1,61 agneaux et 20,5 kg de poids vif par agnelage respectivement. Les performances de croissance pré sevrage sont fortement influencées par les facteurs fixes étudiés (mode de naissance, âge de la mère et sexe). Ces performances pourront être davantage améliorées par la sélection d'animaux selon des schémas adaptés. La nouvelle race devrait ainsi constituer un vecteur important de développement de l'élevage ovin dans les zones agricoles favorables.*

***Mots-clés**. Elevage ovin – Races synthétiques – Deroua – Prolificité – Maroc.*

I – Introduction

Composite breeds that combine traits of interest allow for optimizing sheep management, while meeting breeders' needs for increasing their production and renewing easily their flocks. Actually, increasing the number and weight of lambs produced per ewe remain the main challenge in meat sheep production. In this context, the development of the composite breed "Deroua" has been undertaken since 2002 at the National Institute of Agronomic Research INRA-Maroc at Deroua farm (32°17'35.9"N ;

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6°33'38.6"W), located at 22 km east of Beni Mellal city. The purpose was to develop a new breed having a prolificacy close to 2 and improved reproduction and growth traits. The development was based on crossing Dman (50%-paternal) and Boujaad (50%-maternal) breeds. The former is characterized by improved reproduction traits such as high fertility and prolificacy (El Fadili, 2019) and the latter is known for its growth potential, meat quality and rusticity (El Fadili and Leroy 2001; El Fadili, 2004; Chikhi and Boujenane, 2003). Individuals of the composite breed were obtained for the first time in 2011 and performance records were made, together with several factors that might be associated with zootechnical performance of this breed. This paper aims at citing reproduction and growth performance of this new breed, based on its first non-selected nucleus of animals raised at the farm of origin, in relation with fixed factors such as the age of ewes and the year of production.

II – Materials and methods

1. Development of Deroua breed

To develop Deroua breed, the crossbreeding scheme was based on mating Dman rams with Boujaad ewes to produce the first generation F1, then to crossbreed F1 rams and ewes to produce the second generation F2, and to continue crossing until stabilizing zootechnical traits (Benjelloun *et al*., 2016). Preliminary analysis of different generations performance showed that the breed stabilized since the 5th generation (F5). Deroua sheep were produced for the first time at Deroua farm of INRA in 2011, 9 years after the start of the program. Sheep were raised indoors under similar reproductive, feeding and prophylactic conditions and on an annual breeding cycle. Rams and ewes with major defects (e.g. rams with one testicle, adult weight <30kg for rams and <25kg for ewes, repetitive health issues) were discarded for reproduction.

2. Reproduction, feeding and prophylactic conditions

Groups of 10-20 ewes were formed and maintained during the program. Males produced within the different groups were used as rams to mate non closely related animals (half-sister/brother). No selection based on zootechnical performance was applied at this stage. Ewes were weighted and exposed to males during 60 days (mostly during June and July) and penned in the ratio 10 to 20 ewes per ram. Ewes were flushed starting 10 days before breeding. Sheep feeding was based mainly on fresh alfalfa, alfalfa hay, cereal straw or corn silage depending on the period and availability. Furthermore, sheep were supplemented with concentrates using barley, sunflower cake or dry beet pulp, depending on physiological state of the animals (reproduction, end of lactation, beginning of gestation…). Prophylactic and sanitary treatments consisted in preventing against enterotoxemia, sheep pox, myopathy and internal and external parasites.

3. Performance checks and studied traits

During the lambing period, born lambs were identified and weighed in the first twelve hours of their life. Then, lambs were weighted every two weeks until weaning. Those weights were used to infer weights at 30 and 90 days and growth rate before weaning. The traits used to assess zootechnical performance of the new breed were (i) fertility, litter size and weight at birth and weaning, as well as pregnancy duration in ewes; (ii) Weight at birth (W0), at 30 (W30) and at 90 days (W90) as well as survival rate at 90 days (SUR90) together with growth rate between birth and 30 days (ADG030) and between 30 and 90 days (ADG3090). Those traits were inferred for 395 ewes and 976 lambs between 2011 and early 2018.

4. Data analysis

Descriptive data (means and standard deviations) were computed using R software (R version 3.5.3; 2019). In order to highlight the effects of fixed factors, variance analysis was performed using linear model via the "LM" function of the same software. The model used for ewe traits was:

$(Variable\text{-}to\text{-}explain)_{jkl} = \mu + (Year\text{-}of\text{-}lambing)_j + (Age\text{-}class\text{-}lambing)_k + b * (Breeding\text{-}weight)_l + e_{jkl}$

The model used for lamb traits was:

$(Variable\text{-}to\text{-}explain)_{ijkl} = \mu + (Birth\text{-}mode)_i + (Sex)_j + (Mother\text{-}Age\text{-}class)_k + (Year\text{-}of\text{-}birth)_l + e_{ijkl}$

Adjusted means and standard deviations were estimated using the function "lsmeans" of the R package "LSMEANS". The quantified effect associated with each level of the studied factors on the zootechnical performances was estimated via the "contrast" function and the "eff" method of the same R package.

III – Results and discussion

1. Ewe performance

The 395 Deroua ewes recorded an average (± sd) fertility of 81 (±39)%. They realized a prolificacy of 1.61 (±0.78) lambs/lambing and a litter weight of 5.12 (±1.88) kg/lambing. The size and weight of litter at weaning was 1.21 (±0.66) lambs and 20.5 (±8.1) kg/ewe. Gestation duration was 151 (±1) days (Table 1).

Lambing performance obtained here is comparable to that of DS breed resulting from the cross-breeding "Dman x Sardi" which registered 82% for fertility, 1.57 lambs/lambing for prolificacy and 20.1 kg for the litter weight at weaning (Boujenane, 2002). However, it is worth mentioning that this last study reported adjusted averages for the fixed factors studied. Moreover, the fertility and prolificacy we obtained are comparable to the performance of the synthetic breed INRA180 resulting from the crossbreeding "Dman x Timahdite", which registred 91% for fertility and 1.6 lambs for prolificacy. However, the latter breed achieves a greater litter weight at weaning reaching 25.5 kg (El Fadili, 2011).

Fixed factors of the linear models that were used explained between 5% (for the prolificacy) and 22% (for the litter weight at weaning) of the overall variation of the studied traits. All of the studied traits were significantly impacted by the year of lambing (3-10% of the overall variation of the studied traits). Low performance was obtained in years 2015 and 2016 compared to the rest years of recording, except for fertility. The age class affects significantly the weight of the litter at lambing and weaning and the litter size at weaning with higher performances obtained by multiparous ewes in comparison with the primiparous ones (Fig. 1A). Furthermore, the weight of the ewe increases significantly the weight of the litter at weaning. The average ratio is 0.25 kg of litter weight each 1 kg of ewe weight.

2. Lamb performances

The lamb growth traits (±sd) were on average 3.19 (±0.77) for the weight at birth (W0) and 16.8 (± 4.3) kg for the weight at weaning. Growth rate averaged at 159 (± 61) g before 30 days and 146 (± 50) g between 30 and 90 days. Survival of lambs at weaning was rather low: 75% as an average (Table 1).

Lamb growth performance obtained here was higher than those of DS lambs, which weighted 2.69, 6.65 and 15.8 kg at birth, 30 and 90 days (Boujenane, 2002). Similarly, Deroua lambs performed similar to lambs of the INRA180 synthetic breed, which achieved 3.01 and 7.23 kg respectively at birth and at 30 days. However INRA180 lambs weighed 17.4 kg at 90 days (El Fadili, 2011). How-

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ever, the survival at weaning recorded by Deroua lambs is substantially lower than that achieved by both DS and INRA180 synthetic breeds, which are respectively 87 and 84% viable (El Fadili 2011). The limited survival rate can be partially explained by the permanent stabling mode, which is marked by some climatic/husbandry concerns that could occur during some periods.
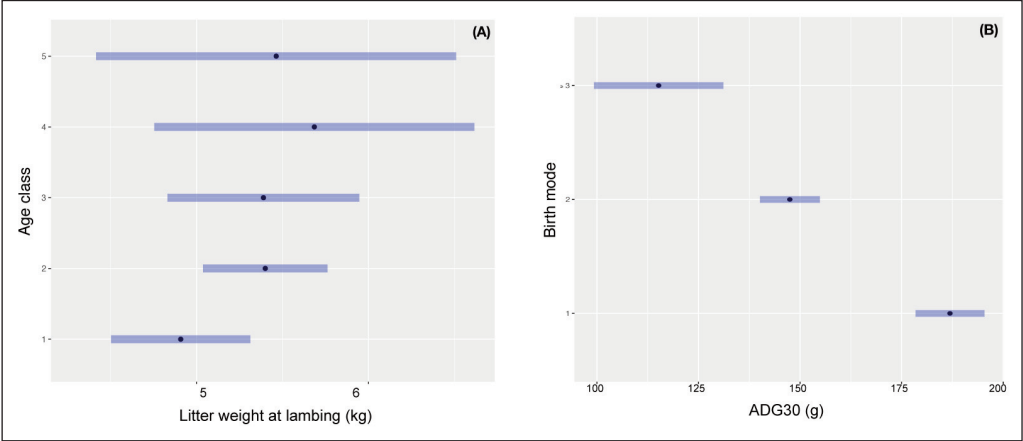

Fig. 1. Adjusted means of (A) litter weight at lambing of ewes depending their age at breeding and of (B) average growth rate of lambs according to their birth mode. Age classes are defined by the ewe age at lambing (1: ≤ 30, 2: 30-42, 3: 42-54, 4: 54-66, 5: 66-78 months old). Birth modes are denoted by 1: single-born, 2: double-born, ≥3: triplets and greater.

Table 1. Average performance on different lamb traits, standard deviations and fixed factors impacting these

Trait	BW (kg)	W30 (kg)	W90 (kg)	ADG030 (g)	ADG3090 (g)	SUR90
Mean ± SD	3.19 ± 0.77	7.99 ± 2.23	16.8 ± 4.3	159 ± 61	146 ± 50	0.75 ± 0.44
Proportion of variance explained by the studied fixed factors (%)	36	32	27	26	25	6
Significative fixed factors	Birth mode (***)	Birth mode (***)	Birth mode (***)	Birth mode (***)	Birth mode (***)	Birth mode (***)
	Sex (***)	Mother age (***)	Sex (***)	Mother age (***)	Sex (***)	Mother age (***)
	Year (**)	Year (***)	Year (***)	Year (***)	Year (***)	Year (*)

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

The fixed factors included in the models explained 25 to 36% of the overall variations of the pre-weaning weights and growing speeds. However, the model used to study survival at weaning explained only 6% of its overall variation (Table 1). The birth mode was by far the main factor that affects significantly all the studied traits (17-32% of the variation of the weights, 7-13% of the variation of the ADG and 3% of the variation of survival at weaning) where single-born lambs were heavier (+0.82 and +1.35 kg for W0, +1.9 and +3.4 for W30 and +3.3 and +5.8 for W90 when compared respectively to double-born and triplets and greater lambs). Similarly, they grew much faster than multiple-born lambs (e.g. Fig. 1B). The effect of this factor on growth characteristics is consistent with the results of most authors on the main Moroccan breeds (El Fadili 2011; El Fadili 2008; Benjelloun 2002, Chikhi 2002; El Fadili & Leroy, 1997). Lamb sex affected significantly the weights at birth and at weaning as well as ADG3090 for which males were heavier and grew faster than females. Average weight difference at weaning was 0.76 kg. The impact of the birth year was significant on all of the studied traits. It was less prominent but significant on W0 and survival at wean-

ing. Lambs born in late 2013, 2016 and 2017 were heavier and grew faster in comparison with those born in late 2011, 2014 and 2015. However survival was high in 2014 and 2015 as well. Considering that the studied sheep were kept continuously indoors, the year could affect sheep performance due to the quality of alfalfa or corn silage made available in each year. Ewe age at birth affected all traits except for ADG3090. Products of multiparous registered higher performances than primiparous lambs. This is consistent with previous studies on Moroccan sheep breeds (El Fadili 2011; El Fadili 2008; El Fadili 2007a; Al Fadili 2007b; Benjelloun 2002; Chikhi 2002; El Fadili and Leroy, 1997).

Rearing Deroua sheep under different conditions would help in getting more information on how the new breed would behave under actual breeding conditions. This would help in depicting additional fixed factors that could impact its performances.

IV – Conclusion

This study highlighted for the first time ewe and lamb zootechnical performance of Deroua the new synthetic sheep breed. It is based on data collected from the first non-selected core of animals of the new breed raised in one farm where conditions are not always perfect. Despite this, performances obtained here are encouraging and comparable with the main previously developed synthetic breeds in Morocco. They allow concluding that the new breed can represent a new genetic resource that could increase sheep productivity. Besides, Morphometric measurements would help in characterizing morphology and standards of the new breed.

Acknowledgements

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