Research Article

In Niger, a Comparative Study of the Growth and Reproductive Performance of Local Azawak and Crossbred Cattle

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Abstract | Niger's cattle genetic resources have a relatively low level of milk and meat production that is influenced by environmental factors. Thus, within the framework of the genetic improvement of cattle, after the selection of the Azawak zebu in 1931, the crossing of this breed with the Alpine Brown by artificial insemination, is experimented in Niger. This work reports the first results of this introduction on growth and reproduction. Data from 52 crossbreds (75%, 50% and 25% of Alpine Brown blood degree) and 63 Azawak were used for reproduction parameters, and 373 animals for growth parameters. The age at first calving of the crossbred cows (34.25 ± 3.77, 29.74 ± 3.37 and 32.80 ± 3.42 months respectively in the 75%, 50% and 25%) is significantly different from those of the Azawak (41.57 ± 6.76 months). The age at fertilization of crossbred cows was 21.38 months compared to 32.57 months for Azawak cows. The calving interval was 17.85 ± 3.60 months and 18.50 ± 5.26 months for crossbred and Azawak cows, with no significant difference. It clearly appears that the crossbred cows grow better and start breeding earlier. These first results of the crossbreeding augur well for the future performance of milk and meat production of crossbred cattle.

Keywords | Production performance, Cattle, Niger.

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INTRODUCTION

Livestock plays a central role in the economy of West African countries as they contributing up to 44% of agricultural (Kamuanga et al., 2008). Niger's economy is primarily rural, and therefore relies on the potential of the primary sector (agriculture and livestock). Livestock occupies 85% of the Nigerien population and contributed more than 12% of GDP in 2008 (Adamou, 2012). Niger has a fairly large livestock production potential with poor production and reproduction parameters. There are five breeds among which are bred: the Nigerien Peul zebu (Djelli), the Azawak zebu, the Bororo zebu, the Goudali zebu and finally the Kouri taurine (Achard and chanono, 1997). Among them, the Azawak zebu has a special place and is rightly considered as the "Jersiaise" of West Africa (Boureima, 1981; Adjou, 2006). It has been targeted among local breeds for improvement due to its potential in both reproduction and milk production. Particular emphasis was placed on the selection of this breed as early as 1931 with the creation of a center for this purpose (Achard and Chonono, 1997). The performances acquired by the selection have limits that do not allow to meet the demand for animal products. Hence the experimentation of crossbreeding by introducing seeds of foreign breeds is much more efficient than our local ones. It is in this sense that the

Alpine Brown (a dairy cattle breed imported from France) has been crossed with the local Azawak breed since 2010 at the Toukounous Sahel Experimental Station. In order to have a reference on crossbreeds, it is necessary to evaluate the performances acquired by this crossbreed. Thus, the purpose of this article is to evaluate the reproductive and growth performances of the crossbred cattle compared to those of the Azawak.

MATERIAL AND METHODS

Study site

The study was conducted at the Toukounous Sahelian Experimental Station (SSET) located 200 km from Niamey, in the Tillabery region of Niger. It covers an area of 4,474 hectare of grazing land subdivided into 30 plots, entirely partitioned and protected by a wire fence (Marichatou et al., 2009). The climate is Sahelian; the vegetation is composed of a herbaceous cover dominated by grasses and legumes and a woody stratum with a super dominance of Acacias, Maerua crassifolia and Balanites aegyptiaca (Ousseina, 2004). The station relies for its water supply on 11 cemented wells, a borehole, and 4 water towers with a capacity of 30 to 50 m^3, with concrete pipes and troughs for watering. The rainy season extends from May to October and the dry season from November to April. The average rainfall from 1997 to 2007 is 409.19 mm (Marichatou et al., 2009).

Animals

Animal breeds used

Two animal breeds were used in this study:

- The pure local cattle breed "Azawak", which was selected at the SSET.
- Crossbred animals resulting from the insemination of Azawak females with Alpine Brown semen. We have 3 types of crosses with different levels of Alpine Brown blood obtained in the 1st and 2nd generation of crosses. Figure 1 of crossing is the following one:

Legend figure 1: F1: 1st generation BA: Alpine Brown-Azawak. 25%: ¼ of Alpine Brown blood; 50%: ½ Alpine Brown blood; 75%: ¾ of Alpine Brown blood.

For growth parameters: this study included 200 Azawak and 173 crossbreds, all reared at SSET under the same conditions (Table 1). They were used to determine birth weights, weights at typical ages and average daily gains.

For reproductive parameters: 52 crossbred females and 63 Azawak females, all of the same age and reared under the same conditions, were used; age at fertile mating, age at first calving and calving intervals were determined.

Animal health management: In terms of health, external and internal deworming was performed twice a year. The animals were also vaccinated against contagious bovine pleuropneumonia, symptomatic and bacterial anthrax and bovine pasteurellosis.

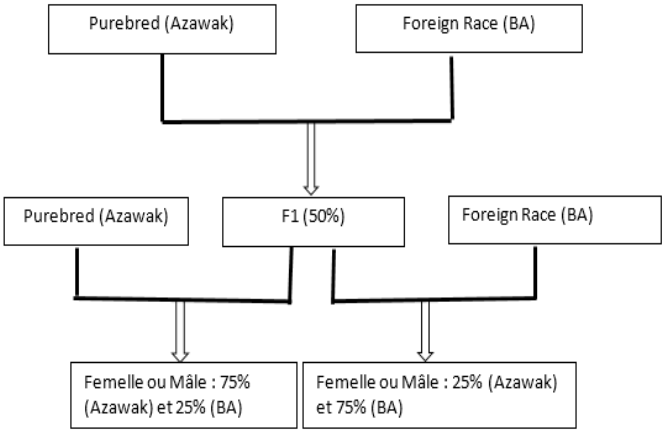

Figure 1: Types of crossover used in our study

Table 1: Number of animals used for growth parameters.

Categories	Azawak	Croisés	Total
Male	95	78	173
Femelle	105	95	200
Total	200	173	**373**

Feeding: the animals are fed on the natural pasture of the station whatever the season. However, in the dry season, the cotton cake is supplemented wich lactating cows and young udders. In addition, the animals receive mineral supplements in the form of lick stones. Finally, it should be noted that water is provided ad-libitum at the station, with temporary pools in the rainy season and troughs connected by a pumping system to wells in the dry season.

Herd management: the young at the udder are separated from their mothers during the day and are only presented to them at milking time. They were used as a stimulus for milking and have their milk meal. After weaning, the herd of weaned females and the herd of weaned males were driven separately to avoid uncontrolled mating. Adult females and males were kept in separate flocks.

Breeding management: all animals used are the result of artificial insemination of Azawak females with Alpine Brown semen (for Alpine Brown-Azawak crosses) and Azawak semen (for pure Azawak).

Data collection

It consisted in the exploitation of the station registers on the one hand, and on the other hand of the vital records of the animals as well as their parents from 2009 to 2018 for the crossbreds and from 2006 to 2018 for the Azawak.

Table 2: Birth weights of Alpine-Azawak Brown and pure Azawak half-breeds according to blood degree and sex.

Breeds	Pure Azawak		Alpine Brown Azawak					
Birth weight (Kg)	100%		75% Brown		50% Brown		25% Brown	
	M	F	M	F	M	F	M	F
	N= 105	N=95	N=15	N=24	N=54	N=63	N=9	N=8
	23,02 ± 1,60**a**	21,88 ± 1,76**a**	30,27 ± 4,25**b**	28,71 ± 4,26**b**	29,82 ± 4,76**b**	29,15 ± 4,68**b**	27,89 ± 3,02**b**	29,36 ± 6,99**b**

Different letters on the same line indicate a significant difference. M: male; F: female; N: number; Kg: kilogram; 25%: ¼ of Alpine Brown blood; 50%: ½ of Alpine Brown blood; 75%: ¾ of Alpine Brown blood and 100%: pure breed.

The information collected includes animal numbers, dams' numbers, fathers' numbers, dates of birth, first calving and calving intervals.

Statistical analysis

Excel 2016 was used to enter the collected data and calculate the means and standard deviations for the birth weights of the animals. SPSS software (version 20) and XLSTAT for multiple comparison tests (ANOVA, t-test, Normality test, Wilcoxon test for two matched samples) was used for the analysis of growth, blood degree and reproduction parameters. The significance level is 5%.

The growth parameters determined are as follows:
Birth weight of calves: is determined from the day of birth using a cattle scale;

Weight at typical ages: is the weight of the animals determined every three (3) months, from birth to 24 months.

Average Daily Gain: indicates the average rate of weight growth during a given period and allows comparison of performance according to the different weights of the animals. We have chosen an interval of three (3) months, which corresponds to 90 days, to determine the average daily gain. The formula is as follows:
ADG=(P2-P1)/(Number of days between P1 and P2)
With P2 = weight at a given age P1 = weight at the previous age.
Reproduction parameters were calculated using the following formulas:
Age at first calving (months) = Time from date of Age from birth to first calving;
Age at fertile service (months) = Age at first calving - 9 months (of gestation);
Calving Interval or Calving to Calving Interval = Time between two successive calvings.

RESULTS

Growth parameters

Birth weights of Alpine Brown and Azawak half-breeds according to blood degree: Table 2 shows the different birth weights. According to the normality test, the calculated p-value is less than 0.05 and the weights of the animals follow a normal distribution. So there is no significant difference between the sexes (male and female), but also between among the degrees of blood (75%, 50% and 25%). But, there is a significant difference at the threshold of P < 0.05 between crossbred and Azawak.

Typical age weights of Alpine Browns-Azawak and pure Azawak

A normality test was performed between males and females on the one hand and according to the degree of blood on the other hand in order to see if there is a significant difference or not. The results are presented in Figure 2 below.

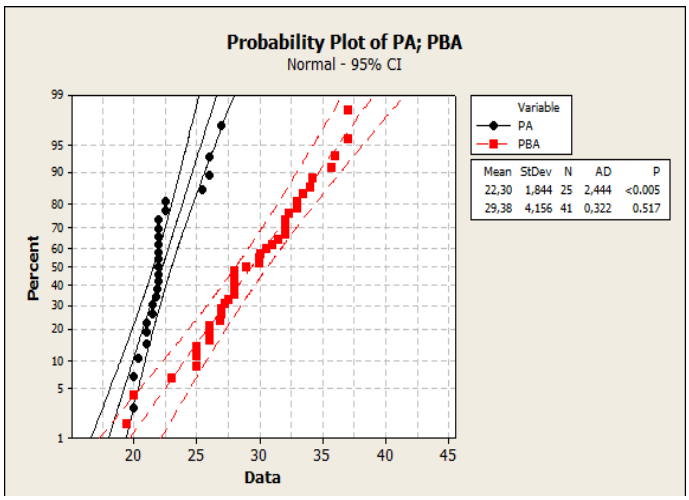

Figure 2: Normality test. Legend: PA: Weight of Azawak, PBA: Weight of Alpine Browns-Azawak

It can be seen from this Figure 2 that since the Alpine Brown-Azawak crosses follow a normal distribution and that there is no significant difference by blood type and sex according to this test, the weights at standard ages are presented in Table 3.

Since Azawak on the one hand and Alpine Brown-Azawak crosses on the other hand, follow a normal distribution and there is no significant difference between the blood degrees of the crosses, the average weights at standard age are reported in Table 3 as follows.

Table 3: Weight at typical age of Alpine Browns-Azawak and Azawak (months)

Weight at typical age (Kg)	Azawak	Alpine Brown Azawak
3 months	61,00 ± 12,09*	68,84 ± 9,64**
6 months	98,75 ± 22,61*	117,96 ± 13,32**
9 months	144,48 ± 22,08*	191,22 ± 24,69**
12 months	190,16 ± 29,38*	242,38 ± 27,16**
15 months	195,20 ± 27,25*	282,60 ± 26,60**
18 months	218,43 ± 15,74*	295,00 ± 50,26**
21 months	307,00 ± 32,33*	376,60 ± 33,35**
24 months	374,5 ± 72,83*	490,50 ± 36,06**

Legend: significance test $p < 0.05$. * : low significance ; ** : very significant.

Table 4: Average daily earnings of Alpine Browns-Azawak and Azawak purebreds

Average daily gain	Pure Azawak	Crossbreed Alpine Brown-Azawak
3 months	38,7[a]	39,78[a]
6 months	37,75[a]	49,12[b]
9 months	45,73[a]	73,26[b]
12 months	45,68[a]	51,16[b]
15 months	5,04[a]	40,22[b]
18 months	23,23[a]	12,4[b]
21 months	88,57[a]	81,6[b]
24 months	67,5[a]	113,9[b]

The means with the different letters on the same line are significantly different at the 5% level.

Table 5: Age at first birth (months)

Breeds	Azawak	Alpine Browns-Azawak		
Degree of blood	100%	75%	50%	**25%**
Number	N= 63	N= 4	N= 43	N= 5
Age at first birth (months)	41,57 ± 6,76a	34,25 ± 3,77b	29,74 ± 3,37c	32,80 ± 3,42b

Different letters on the same line indicate significance at the 0.05 level.

Table 6: Calving interval or calving-to-calving interval (months)

Breeds	Azawak	Alpine Browns-Azawak
Degree of blood	100%	50%
Number (N)	N= 63	N= 36
Calving-Calving Interval	16,59 ± 5,51 a	17,65 ± 5,33 a

The same letters on the same line indicate that there is no significant difference at the $P < 0.05$ level.

Table 3 shows that the weights at standard ages of the crossbred cows are higher than those of the Azawak cows, from the third to the 24th month of age, with a significant difference at the threshold of $P < 0.05$.

Average daily gain (ADG) of Alpine Browns-Azawak and Azawak

Table 4 presents the average daily gain of the crossbred and Azawak at the Toukounous station from 0 to 24 months. It appears from Table 4 that whatever the age class, some animals have definite growth potential. Thus, we notice in the interval from 18 to 21 months a significant increase in the GMQ in both subjects. From this age onwards, the Average Daily Gain (GMQ) of the crossbred animals increases while that of the Azawak animals decreases.

Reproduction parameters

Age at fertilization: Figure 3 shows the age at fertilization of the crossbred and Azawak. Figure 3 shows that the age at fertile mating of the half-breeds is lower than that of the pure Azawak with an average of 21.38 months for the half-breeds and 32.57 months for the pure Azawak.

Age at first birth: The age at first birth is presented in Ta-

ble 5. It appears from this table that the age at first calving of Azawak is higher than that of crossbred cows, with a significant difference.

Calving Interval or Calving to Calving Interval (months)

Table 6 reports the different calving intervals for purebred and mixed-breed Azawak cows.

From this Table 6, it can be seen that the calving interval is not different between the two genetic types.

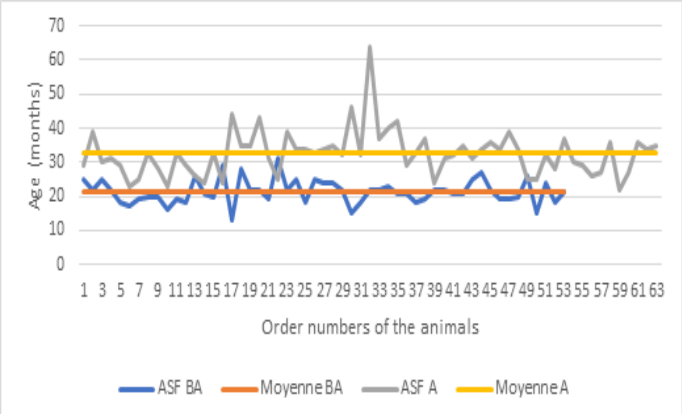

Figure 3: Age at fertilization

Legend: ASF BA : Age at fertilization of Alpine Browns; ASF A: Age at fertilization of Azawaks; Average BA: Average age of Alpine Browns; Average A: Average age of Azawaks.

DISCUSSION

The study determined the age at fertile mating, age at first calving and calving interval of purebred Azawak and crossbred cattle at the Toukounous Sahelian Experimental Station (SSET). Growth parameters were also calculated for both breeds.

The birth weight of the Alpine Brown-Azawak crossbred cattle was higher than that of the Azawak crossbred cattle which. This study shows that the crossbred animals are significantly heavier at birth than the Azawak. This trend was observed by Bouyer (2006) in Guinea, who reported that N'Dama males have an average weight of 15.8 kg, significantly lower than that of N'Dama× Holstein (24.3 kg), N'Dama× Montbeliard (23.3 kg) and N'Dama× Brunes des Alpes (24.1 kg) crossbreds.

This can be explained by an individual effect related to the father of the calves. In fact, among the factors affecting the birth weights of calves, there are mainly genetic factors. Among these factors, those that are indirectly acting are sex and type of cattle. Thus, in the case of this study, males are always heavier than females at birth without the difference being significant. Regarding direct-acting genetic factors, there are breed and sire (Angel et Poly, 1956). This is true in this study as the local Azawak breed is compared to a product of its cross with a foreign breed that is heavier at adult weight. However, Bouyer's data are lower than ours, which is due to the fact that the N'Dama (bull breed) is smaller in size than the Azawak (zebu breed).

As for average weights at typical ages, growth is more accelerated in the crossbred than in the Azawak from 0 to 24 months, i.e., 2 years; at this age, there is a weight difference of 115 kg between the two. Bouyer in 2006 in the Republic of Guinea observed the same trend between N'Dama and crossbreds at 6 months (67 kg versus 94.6 kg, 100.1 kg, 115.8 kg respectively for N'Dama-Montbeliard, N'Dama-Brunes des Alpes and N'Dama-Holstein crossbreds). Also, the GMQ between typical ages was higher for crossbreds than for Azawak from 0 to 15 months, hence the high growth rate of crossbreds.

Regarding the age at fertilization, the results of the study showed that it is 21.38 ± 3,63 months in the crossbred cattle (75%, 50% and 25% of Alpine Brown blood), which is shorter than those of pure Azawak cattle which are 32.57 ± 6,76 months. Thus, the average maximum or minimum values of age at fertilization in mixed-breed cattle are lower than those of pure Azawak cattle at 31.13 and 64.22 months respectively. These results are lower than those reported by authors for Montbeliarde and Holstein crossbred cattle, where the average age at first fertilization is around 30 months, for Brune des Alpes-Ankole crossbred cattle, 29.7 ± 0.8 months and 38.4 ± 0.8 months for the local Ankole breed in Congo (Kibwana et al., 2012; Ndeye, 2005; Madjina, 2015). Our values for crossbreds are close to those reported for pure breeds by Boujenane et al, (2008) in Morocco (28.9 and 29.6 months for Holstein and Montbeliarde) and Haddada et al. (2005) in Morocco (27.52 months for Holstein).

Concerning the age at first calving, it is very important in zootechnics because females that give birth early are those that will have a long and good reproductive career (Boutrais, 1988; Hammami et al., 2013). The age at first calving was 29.74 ± 3.37 months in the 50% Alpine Brown crossbred females, significantly lower than the other crossbred females (75% and 25%) (34.25 ± 3.77 and 32.80 ± 3.42), in turn significantly lower than the pure Azawak (41.57 ± 6.76 months). Our crossbred results are comparable to those of the Brune des Alpes in Burundi (30 to 31 months) (Nimubona, 2003), Senegal (34 ± 4 months) (Ndeye, 2005), Montbéliard-N'Dama crossbred in Côte d'Ivoire (37.0 ± 5.0 months) Gbodjo et al. (2013), Holstein-Gobra and Montbéliard-Gobra crossbred in Senegal (39.5 ± 11.3 and 40.3 ± 10.3 months respectively) (Ndeye, 2005). Crossing between the Brune des Alpes (foreign breed) and the Azawak (local breed) had a positive effect

on this parameter.

It should also be noted that the age at fertilization of Alpine Brown-Azawak crosses (75%, 50% and 25% Alpine Brown blood) is lower than that of Azawak (21.38 months versus 32.57 months). It is reported that genetically, heifers with high growth potential tend to be pubescent at a younger age (Hafez, 1987; Lhoste et al., 1993; Mialon et al., 1995). This supports our data because crossbreds have accelerated growth compared to pure Azawak and it is known that puberty is more correlated with weight than age.

On the other hand, the interval between calvings is almost the same for crossbred cows and Azawak cows (17.85 ± 3.60 and 18.50 ± 5.26 months respectively). It should be noted that Azawak cows are bred spontaneously in herds with a permanent sire, whereas insemination is programmed at times, which must have affected the calving intervals of crossbred cows. These results are close to the values found in Montbeliarde-N'dama crossbreds in Côte d'Ivoire (15.18 ± 3.01 months) by Gbodjo et al. (2013), in Brune des Alpes-Ankole crossbreds (16.5 ± 0.5 months) by (Kibwana, 2012). They are higher than that of the pure breed Brune des Alpes bred in Burundi (12.97 months) (Nimubona, 2003).

CONCLUSION

Our study allowed us to determine the reproductive performance of mixed-breed and Azawak cattle. Thus, it is clear that the age at fertilization, age at first calving and calving interval of the Alpine Brown-Azawak crossbred cattle are significantly better than those of the pure Azawak at the Toukounous Sahelian experimental station. Thus, crossbreeding between the foreign breed and the (local) Azawak is very profitable and can be proposed to the breeder in order to increase the growth and reproductive performance of our local breeds.

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CONFLICT OF INTERESTS

There are no competing interests.

NOVELTY STATEMENT

Thus, crossbreeding between the foreign breed and the (local) Azawak is very profitable and can be proposed to the breeder in order to increase the growth and reproductive performance of our local breeds.

AUTHORS CONTRIBUTION

Professor Marichatou Hamani; Professor Moumouni Issa et Doctor Abdou Moussa Mahaman Maâouiahave contributed to the field practice and writing of this work. Marichatou Hamani is the
director of my thesis.

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