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# Reproductive Performances and Kid's Mortality of Pure Breeds and Crossed Caprine Genotypes in the Coastal Oases of Southern Tunisia

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**Abstract:** In order to improve goat productivity in the arid regions of Tunisia, a crossing scheme of the local goat population by high performance breeds was applied under oases conditions. To cross local population, Alpine, Damascus and Murciana Granadina breeds were imported and used as paternal genotypes in several cross generation. The survey of pure breeds and crossed genotypes permitted to collect the zootechnical performances during 16 years under an intensive breeding mode. The analysis of 644 fertility, prolificacy, fecundity, abortion and sterility and kid's mortality ratio showed an important difference between the studied genotypes performances. The local goat prolificacy rate was 153% in average. The kid's mortality ratio was the highest for Alpine breed and its crossed genotypes with a ratio of 4 and 3%, respectively. The first and the second generations, the crossed Damascus x Local had a fertility of 98 and 100%, showing an important heterosis effect. Also, the reproductive performances of the imported breeds were largely lower than those of the local population. Kid's mortality and reproductive performances are largely related to the genotype adaptative potentialities.

**Key words:** Local goat population, cross breeding, reproduction, mortality, Tunisian oases

## INTRODUCTION

The *Capra hircus* is considered being the oldest domesticated animal among livestock species and goat has varied its breeds and products to justify its actual large distribution (Alexandre *et al*., 1997a; Fabre-nys, 2000). In Tunisia, the national caprine herd is estimated at approximately 1,300,000 reproductive females and more than 60% of the national herd is raised on the arid rangelands of the country (DGPA, 2002; Najari *et al*., 2006). Since centuries, local goat population has been valorizing the arid pastures with scarce resources and harsh climatic environment. Local goat is essentially raised in pastoral mode and is often considered able to reproduce during all the years, as well as for other caprine rustic populations (Chemineau *et al*., 1991; Alexandre *et al*., 1997b; Delgadillo *et al*., 1997; Greyling, 2000; Arbi, 2004). The lactated kid's meat is the main product for this breeding mode and contributes with about 75% in the regional meat production (Najari *et al*., 2007).

Under oasian conditions, the goat husbandry contributes in the farmer's incomes (D'Aquino *et al*., 1995; Jamali and Villemeot, 1996). Goat benefits from an intensified breeding mode under low climatic risks which characterize the arid area (Morand-Fehr and Doreau, 2001; Snyman, 2004). It is well known that the heat peaks and stresses affect caprine reproduction, as well as for all the mammalies species (Williams and Helliwell, 1993; Arbi, 2004). Under intensive oasian husbandry, the low productivity was attributed, in part, to local goat genetic potentialities (Najari *et al*., 2002; Pasquini *et al*., 1994). Thus, to improve caprine productivity and to optimize oases resources valorization, a crossing plan of the local goat was adopted as a solution to resolve this genetic problem. The crossing project was started since 1981.

Based on a large data base issued from 16 years animal survey of pure breeds and crossed genotypes performances, several studies was realized to evaluate genotypes productivities (Najari and Ben Ahmed, 1996; Najari, 2003; Hatmi *et al*., 1998; Gaddour, 2005). All these studies evaluate the genotypes productive behavior through comparing kid's growth and dairy performances of the pure breeds and the crossed genotypes. So, the reproductive and the kid's mortality were not studied in spite of their significant relation with genotype productivity. In fact and regardless of the production objective, goat productivity success remains largely assessed by reproductive performances and kid's survival (Delgadillo *et al*., 1997). It's well

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known that indigenous goats breeds shows relative good reproductive parameters and kids survival even though in hot climates (Le Gal Planchenault, 1993; Guney *et al*., 2006).

The present study aims at analyzing the large set of data to evaluate and compare the reproductive performances and kid's mortality of local goat, pure breeds and crossed genotypes in the oases breeding mode. Genetic groups' performances were evaluated through some annual reproductive indexes comparison. The results would help in the choice of the best ameliorative breed and the crossing level to improve oasian goat potentialities with respect to this specific breeding mode factors.

## MATERIALS AND METHODS

**Study area:** The study was carried out in the Institute of the Arid Areas station of Chenchou (Southern Tunisia, latitude: 33°29' 57.8 north and longitude: 10°38' 37.3). The station is located in the lower arid bioclimatic stage; with an average annual rainfall of 188 mm. January is the coldest month of the year, with an average temperature of 10.7°C, whereas August is the hottest with about 27.3°C average (Ouled Belgacem, 2006). The project was started since 1981.

**Animal material:** The crossing scheme (Fig. 1) aims to substitute local goat by more productive crossed genotypes. So, some breeds (Alpine, Damascus and Murciana) were used as paternal breed.

**Local goat:** The indigenous goat population shows a large variability both in morphology and performances (Najari *et al*., 2007). The local goat population is characterized by its small size with an average height of 76 cm for the male and 60 cm for the female (Ouni, 2006; Najari *et al*., 2007). It is distinguished by the ability to walk long distances, water shortage resistance and good kidding ability. The native goat is hairy and basically black coat colored with spots on the head horned and has bread and dewlap on the neck. Fertility rate is about 87% and prolificacy rate varies between 110 and 130% (Najari *et al*., 2006). Kidding season begins in October and continues till February with a concentration in November and December when 69.2% of kid's are born.

**Ameliorative breeds:** Three ameliorative breeds were used in the crossing scheme : Alpine, Damascus and Murciana breeds were imported respectively from France, Cyprus and Spain since 1980. Table 1 shows the characteristics of the imported breeds (Najari, 2005).

**Crossing scheme:** To produce the first crossed generation, local goats were mated with bucks of ameliorative breeds. For later crossing stage, at each generation, the crossed females were mated with bucks of imported breeds as indicated in Fig. 1. So, the crossing scheme allows a progressive increase of the ameliorative percentage genes pool, during successive generations (Gaddour *et al*., 2006). Theorically, the crossing plan will be considered as achieved with reaching crossed genotypes performances similar to those of the ameliorative breeds.

**Data collection and genotype parameters estimation:** The study use the data issued from the control of reproduction and mortality relative to various goat

Table 1: Characteristics and performances of the ameliorative breeds

| | | Adult weight (kg) | | Dairy production | |
|---|---|---|---|---|---|
| Breed | Origin | Male | Female | Total production (kg) | Lactation period (days) |
| Alpine | France | 80 | 60 | 570 | 245 |
| Murciana | Spain | 70 | 50 | 500 | 210 |
| Damascus | Cyprus | 80 | 60 | 200 | 90 |

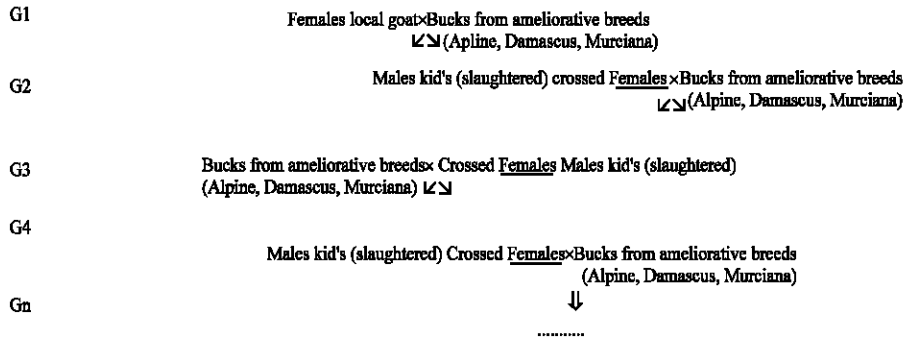


Fig. 1: Local goat cross breeding diagram

genotypes. During 16 years (1980 to 1996) survey, the following data were collected for each genotype: Genotype, year, total goats at mating, total aborted goats, total pregnant goats, total of kidding, male kid's, female kid's, single kid's and multiple kid's. A data file was built and checked before analysis.

A total of 644 genotypes controls were retained and the reproductive parameters and kid's mortality ratio were annually estimated for each genotype according to the following formulas and integrated in the data file before analysis:

Fertility rate = (Total of covered females/Total of females at mating)* 100
Prolificacy rate = (Total of births/Total of kidding females)* 100
Fecundity rate = (Total of births at kidding/Total of females at mating)* 100
Abortion rate = (Total aborted females/Total of females at mating)* 100
Sterility rate = (Total of sterile females/Total of females at mating)* 100
Mortality ratio at birth = (Total of the died births/Total of kid's)*100
Mortality ratio and weaning = (kids died before weaning/Total of the kid's)*100

The numerical analysis was done by data exploration to elaborate statistical indicators such as: Means, standard deviations... Statistical analysis, per genotype and year, was performed using an SPSS logiciel.

## RESULTS AND DISCUSSION

**Reproductive performances of goat genotypes:** Table 2 and 3 summarize reproductive parameters of studied genotypes. Table 2, shows that among pure breeds, Damascus was the most fertile with a rate of 95%. The local goat was the most prolific with an average of 1.5 kids' by kidding. The Alpine breed presents a relatively high rate of abortion witch reached 8% in average.

Table 2: Reproductive parameters (%) of local goat, Alpine, Damascus and Murciana breeds

| Genetic groups | Fertility | Prolificacy | Fecundity | Abortion | Sterility |
|---|---|---|---|---|---|
| Alpine | 88.59 | 143.68 | 127.07 | 8.00 | 3.51 |
| Damascus | 95.00 | 136.86 | 129.71 | 3.66 | 1.53 |
| Murciana | 88.04 | 133.90 | 118.27 | 4.38 | 7.58 |
| Local | 92.71 | 153.43 | 142.50 | 3.17 | 4.12 |

Table 3: Reproductive parameters (%) of crossed local×Alpine, local×Damascus and local×Murciana breeds

| Genetic groups | Fertility | Prolificacy | Fecundity | Abortion | Sterility |
|---|---|---|---|---|---|
| A1 | 93.38 | 132.80 | 125.07 | 4.58 | 2.04 |
| A2 | 84.01 | 135.16 | 113.75 | 8.91 | 7.08 |
| D1 | 98.44 | 155.32 | 153.75 | 0.00 | 1.53 |
| D2 | 100.00 | 140.64 | 140.67 | 0.00 | 0.00 |
| M1 | 95.14 | 141.19 | 136.14 | 1.18 | 3.69 |
| M2 | 95.00 | 111.11 | 105.00 | 5.00 | 0.00 |

(A1, A2: crossed Alpine×local at first and second generation; D1, D2: Crossed Damascus×local at first and second generation; M1, M2: Crossed Murciana×local at first and second generation)

The prolificacy ratio of the local goat was higher than the Alpine and Damascus. It seems that the local population had a genetic structure allowing to improve prolificacy with breeding intensification. This aspect as concluded by Najari *et al.* (2002) and is verified for others animal rustic groups. Local goat adaptation is also illustrated by low abortion and sterility ratio. The performances of the first crossed generation (A1, M1 and D1) were higher than those of the several second generations (A2, M2 and D2). It could be explained by the heterosis effect upon caprine reproductive performances (Griffing and Zsiros, 1971).

Figure 2 and 3 illustrate prolificacy and fertility ratio evolution during the control period. The annual variation of prolificacy ratio was more significant for ameliorative breeds. During the studied period, the effect of the interaction genotype×environment is clear since the genotypes responses to year conditions are not homogeneous. Some genotypes vary their annual fertility and prolificacy more than others. Note also that the local goat prolificacy ratio increase during the control period as explained above.

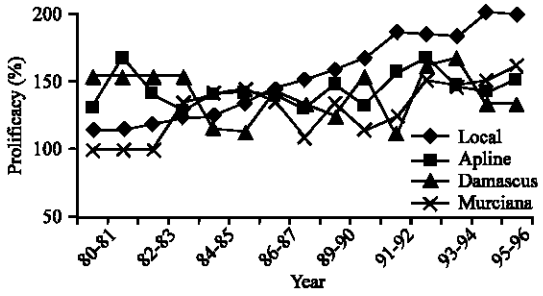


Fig. 2: Prolificacy performances (%) of local goat, Alpine, Damascus and Murciana breeds per year

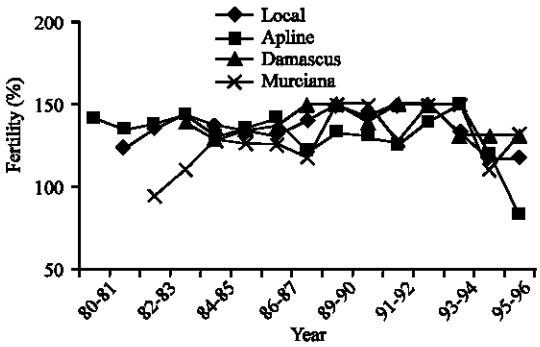


Fig. 3: Fertility performances (%) of local goat, Alpine, Damascus and Murciana breeds per year

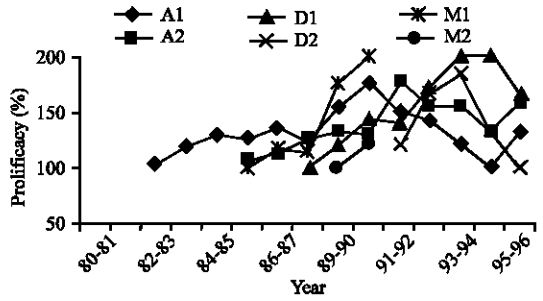


Fig. 4: Prolificacy performances of crossed Alpine, Damascus and Murciana breeds by year. (A1, A2: crossed Alpine×local; D1, D2: crossed Damascus ×local; M1, M2: crossed Murciana × local)

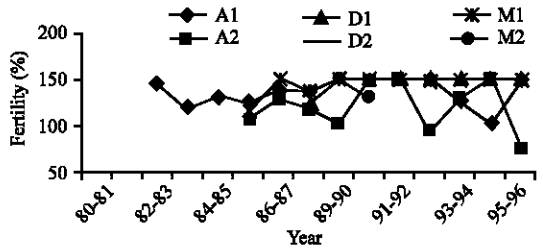


Fig. 5: Fertility performances of crossed Alpine, Damascus and Murciana breeds by year (A1, A2: crossed Alpine x local; D1, D2: crossed Damascus × local; M1, M2: crossed Murciana × local)

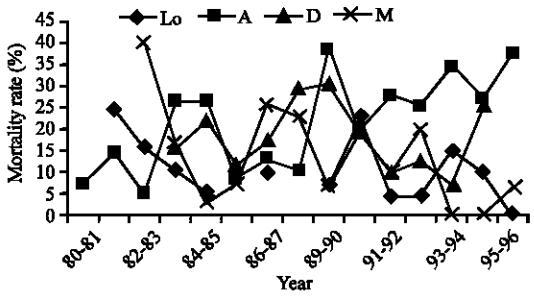


Fig. 6: Kid's mortality rate (%) before weaning for pure breeds. (Lo: Local, A: Alpine, D: Damascus and M: Murciana)

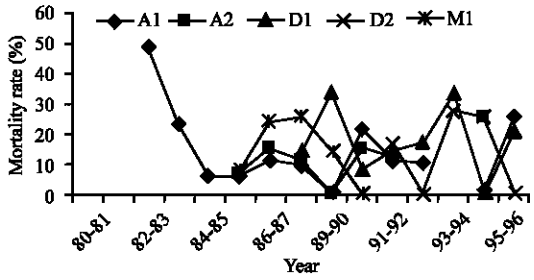


Fig. 7: Kid's mortality rate (%) before weaning for crossed genotypes. (A1, A2: crossed Alpine × local; D1, D2: crossed Damascus × local; M1: crossed Murciana × local)

Table 4: Mortality rate of kid's for the studied pure genotypes (%)

| Genetic groups/frequency | Mortality rate at birth | Mortality rate at weaning |
|---|---|---|
| Alpine | 4.00 | 21.00 |
| Damascus | 1.37 | 17.99 |
| Murciana | 0.48 | 14.05 |
| Local | 1.52 | 13.56 |

Table 5:. Mortality rate of kid's for the studied crossing genotypes (%)

| Genetic groups/frequency | Mortality rate at birth | Mortality rate at weaning |
|---|---|---|
| A1 | 2.94 | 14.29 |
| A2 | 6.91 | 10.68 |
| D1 | 0.00 | 17.45 |
| D2 | 1.82 | 13.79 |
| M1 | 0.00 | 14.05 |
| M2 | 0.00 | 0.00 |

(A1, A2: crossed Alpine×local; D1, D2: crossed Damascus×local; M, M2: crossed Murciana×local)

The crossed genotypes performances are illustrated by Table 3, Fig. 4 and 5. Results showed that M2 (M×Lo) registered the lowest reproductive performances whearas the Damascus crossed had the best potentialities. The Alpine crossed presented the highest sterility and abortion ratio.

However, the crossed average performances do not allow to evaluate correctly the reproductive behavior. So, analyzing the parameters evolution per year (Fig. 4 and 5) is necessary. Crossed parameters vary largely from a year to another.

During the year 1989/1990, results showed a decrease of prolificacy and fertility rates for the crossed groups.

**Kid's mortality:** Table 4 and 5 illustrate the kid's mortality at birth and till weaning, Fig. 6 and 7 present kid's survival parameters per studied year. The kid's survival has a particular impact on the herd productivity due to the kid's meat economical importance in the study area.

In spite of the importance of the hygienic control in the experimental herd, the kid's mortality ratio seems very high. The importance of the total of kid's died before weaning can be explained only by management problems in the experimental station and the main causes of mortalities are due to respiratory diseases (Karua and Banda, 1990; Okello, 1993; Awemu *et al*., 1999).

The pure and crossed Alpine kid's show the highest mortality rates at birth with 4% as the average ratio, this ratio reaches 21% at weaning. We can also conclude that the kid's mortality is mainly observed after birth Table 4 and 5. For example, the mortality ratio at weaning represents 5.25 and 30%, respectively for Alpine and Murciana. So, kid's survival can be improved with better technical and management cares. Even the local goat, which seems to be more adapted to the arid environment,

manifest high mortality; this can be explained by a relative fragility under intensive oasian conditions. Also, a higher prolificacy can contribute to higher kid's mortality (Chemineau *et al*., 1991). So, the genotype adaptation is relative for the original environment and can't be extrapoled to other production modes (Najari and Ben Ahmed, 1996; Alexandre *et al*., 1997b).

Figure 6 and 7 present the kid's mortality at weaning, during the same year, this parameter vary largely showing a relative response to ambiantal factors. During some years, such 1986/1987, the best survival parameters was registered for all pure and genotypes. However, during other years, the survival behavior is different for each genotype in function of the genetic groups.

## CONCLUSIONS

The production mode intensification improves local goat reproductive performances; especially prolificacy ratio witch reaches 154% in average. The local kid's mortality was increased showing that the local population can have survival problems under intensive conditions. Also, pure breeds presented lower performances with respect to their original region. Although under intensive oasian conditions the environment exerce a significative effect upon caprine performances. The cross breeding seems not to improve significatively the local goat reproductive performances, except when the Damascus where used as the parental breed. Crossing with Alpine generate lower performances among the crossed genotypes. A heterosis effect appears clear upon caprine reproduction, the reproductive behavior during years, vary largely with genotypes.

The reproductive potentialities analysis appears necessary to allows better paternal breed choice. Equally, the study of other productive and reproductive caprine performances remains necessary to complete the genotypes productivity index as a step to produce performed crossed genotypes witch improve local goat oasian husbandry incomes.

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