BREEDING PROGRAM FOR THE GENETIC IMPROVEMENT OF DECCANI SHEEP OF MAHARASHTRA, INDIA

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INTRODUCTION

Deccani sheep are coarse-wooled sheep reared mainly for lamb production on the semi-arid Deccan plateau in Maharashtra and Karnataka States of India. Reproductive rate is an important component of the economic efficiency of meat sheep production. The average litter size of Deccani sheep is low, being 1.04. In a break from the objectives of past breeding programs implemented by the State government, research is being done to investigate the practicality of increasing the prolificacy and worm-resistance of Deccani sheep.

CLIMATE AND PRODUCTION SYSTEM

The breeding program is being carried out at Phaltan, situated at latitude 18 degrees north and longitude 74 degrees east. There are approximately 0.5 million Deccani sheep within a 100 km radius of Phaltan. The annual average rainfall in this rain-shadow area is 450 mm and 80 % of it falls between August and October. Droughts occur every 3 to 5 years. 70 % of the sheep flocks from the dry area migrate in the dry season either to nearby irrigated areas or up the mountains to the west. Sheep are herded to graze by the road-sides and on crop residues and are yarded at night in pens or on farmers' fields for manuring. Grazing rights and tree pods are sometimes purchased in exchange for manure. Expenditure on sheep-rearing in cash terms is probably only Rs.20 (US$ 0.5) per sheep per year.

PRODUCTION PERFORMANCE OF DECCANI SHEEP

Results of NARI's studies in four local shepherds' flocks over a 16 month period have quantified the productive performance of Deccani ewes. The average adult weight of Deccani ewes is about 30 kg. The least squares mean weight of lambs at 3 months is 14 kg. The average lambing interval (mean ± SE) is 8.8 ± 2.7 months (calculated for only those ewes which lambed more than once during the study) and weight of lamb weaned per ewe per year is 17.7 ± 2.4 kg. In two of the flocks, 4 out of 172 (2.3 %) lambings produced twins. The least squares mean weight at 2 months of single lambs was 11.2 ± 0.3 kg compared to 10.7 ± 0.9 kg of twin lambs and this difference was not significant (P = 0.6) verifying the benefits of increased prolificacy. The average age at sale of male lambs was 90 to 110 days in different flocks. Most shepherds feel that Deccani ewes that have twins are able to rear them independently.

DEVELOPMENT OF THE BREEDING PROGRAM

The Garole sheep of Sunderban, West Bengal is the only reported prolific sheep breed in India. Sunderban is swampy, a habitat conducive to diseases. It was therefore expected that along

with gene/genes for prolificacy, Garoles may also have useful genes for resistance to internal parasites, liver fluke and other diseases such as footrot. The Garole breed had not been studied systematically when the project at NARI took shape in 1993 - 1994. One of the aims of the project was to collect reliable data on the performance of these unique sheep.

Step 1. Evaluation of genetic differences between and within three Indian sheep breeds. In addition to the Deccani (D) and Garole (G) breeds, it was considered desirable to introduce the Bannur (B) breed (reported to be the best breed in India for meat conformation) from the adjacent Karnataka State into the crossbreeding program for its economically important traits of woollessness, hardiness and good carcass conformation. The main objective was to evaluate lamb production and parasite resistance of the D, B and G breeds of sheep reared under conditions similar to those in which local shepherds' flocks are maintained. A diallel breeding design was envisaged but could not be accomplished because there were not enough G ewes available and the G were found not to be adapted to the prevalent harsh grazing conditions. The breeding program was implemented each year from 1996 to 1999, using artificial insemination with fresh diluted semen. Over 4 years, 290 D ewes and 265 B ewes were inseminated with the semen of 8 D, 9 B and 15 G rams and the resulting progeny evaluated.

Least squares means (± SE) of three-month weights of lambs sired by D, B and G sires were 9.5 ± 0.5, 9.3 ± 0.5 and 8.2 ± 0.5 kg respectively ($P < 0.001$) while their six-month weights were 14.5 ± 0.7, 13.7 ± 0.7 and 11.2 ± 0.7 kg respectively ($P < 0.001$). The reproductive performance of D ewes was superior to that of B ewes. Lambs of G sires were found to be significantly more resistant to the roundworm *Haemonchus contortus*, endemic to most tropical grazing regions, than lambs of D and B sires. However, there was significantly greater mortality before the age of six months among lambs of G sires (13.8 %) compared to lambs of D (7.7 %) and B sires (5.1 %). There was 34 % mortality among stallfed pure G lambs at Phaltan. The reduction in size caused by crossbreeding with the G, is also unacceptable to the local shepherds. Our recent studies on the epidemiology and productive consequences of internal parasite infection in shepherds' flocks suggest that parasitic infection is a relatively minor constraint for Deccani sheep under local climatic conditions.

Step 2. Genetic basis of prolificacy in the Garole breed. Another breeding program was started simultaneously at NARI with the objective of demonstrating segregation of a postulated single major gene for prolificacy in the G breed. Historical accounts suggested the reasonable hypothesis that the origin of the major gene for prolificacy in the Booroola Merino sheep of Australia was the G sheep from West Bengal (Turner, 1982). Ten GxD rams were backcrossed to 50 D ewes per ram. The plan was to test if microsatellite markers closely linked with the Booroola gene segregated with prolificacy as determined by measuring ovulation rates and litter sizes. Early results of ovulation rates pointed to single-gene control of prolificacy in the G. It was therefore decided that the best strategy would be to introgress only the prolificacy gene from the G into the D via backcrossing. Therefore, in 2000, 17 GxD and 10 GxB ewes were inseminated with Bannur and Deccani ram semen respectively ; 17 DxB and 33 BxD ewes were inseminated with GxD ram semen and 30 D and 24 B ewes were inseminated with D and B ram semen respectively to have contemporary purebred lambs available for comparison.

The average litter size of 14 lambing GxD ewes was 1.60 and that of 10 GxB ewes was 1.70 as compared to 1.02 of D and 1.03 of B ewes. Despite the highest mortality (of all genotypes) of lambs up to 3 months (29.4 %), GxB ewes had 1.20 lambs (at 3 months) alive per ewe inseminated and GxD ewes had 1.06 lambs alive per ewe inseminated compared to 0.90 for BxD ewes, 0.87 for DxB ewes, 0.81 for D ewes and 0.75 for B ewes. This was because of the high conception rate and high average litter size at birth of F1 Garole ewes. The economic advantage of twin-producing ewes was also evident when the trait 'weight of lamb weaned per ewe lambing' was analysed for all ewes lambing from 1996 to 2000. Thirty six twin-bearing ewes weaned 4.8 ± 0.9 kg more weight of lamb than single-bearing ewes even though there was 20.8 % mortality among twin lambs compared to 6.5 % among singles. Considering that half of these ewes were smaller-sized F1 Garoles, the advantage of twin-bearing is likely to be substantially higher in Deccani ewes.

It has recently been confirmed that the single gene for prolificacy in the G is identical to the Booroola (FecB) mutation (Davis *et al.,* 2002). A test to identify the Booroola mutation has now been established at the National Chemical Laboratory (NCL) in Pune, India, one of the collaborators in the project and some backcross ewes have been tested for the presence of the mutation. The average litter size at the first lambing of 12 ewes carrying one copy of the Booroola gene was 1.5. It can therefore be concluded that one copy of the Booroola gene increases litter size by 0.5 in D ewes. This would be a modest and manageable increase in the prolificacy of Deccani ewes.

Step 3. Introgression of the Booroola gene into the Deccani and a composite. An increase in prolificacy necessitates an increase in the dam's milk production. To improve milk yield and to compensate for the decrease in size due to crossing with the G, the tropical dairy Awassi (A) breed available with the Nimbkar Agricultural Research Institute (NARI) was introduced into the breeding program in 2001.

On the basis of information collected in the field over the last 5 years, it is now planned for NARI to address two parallel breeding objectives ; (1) to produce a fecund D which can be reared in the local shepherds' environment and (2) to produce a fecund composite for a more intensive production system using infusion of A and G breeds into DxB and BxD ewes. The breeding program will be accelerated by using the FecB DNA test to select or cull sheep. To achieve the first breeding objective, 100 D ewes will be mated to 25 % G- 75 % D rams which carry one copy of the Booroola gene and 100 25 % G – 75 % D ewes carrying the Booroola gene will be mated to D rams. The resulting progeny will be tested for the presence of the Booroola gene and only those carrying the Booroola gene will be reared for further breeding. The 87.5 % carriers will be backcrossed once more to the Deccani to reduce the proportion of Garole genes further. In 2004, some 87.5 % Deccanis with one copy of the FecB gene will be mated to like rams to produce FecB homozygotes. It will then be decided whether the FecB heterozygote or homozygote Deccani is the appropriate genotype for the local production system. If FecB homozygotes have manageable litter sizes, the breeding strategy to achieve the desired level of prolificacy would be simpler. The performance of the final genotypes will be evaluated extensively under local conditions.

Problems, successes and failures. The direct involvement of researchers on this project with the local shepherd community has been another strength of the project to date. NARI is carrying on a program of extension among shepherds and has recently started a survey of sheep management practices of the shepherds and the economics of sheep rearing as perceived by them. Project staff at NARI developed their own effective techniques for the use of non-conventional feed resources in 2000 - 2001, in one of the worst droughts in the last 30 years. It is, however, evident from a comparison of lamb weights from shepherds' flocks that sheep management at NARI needs to be improved. NARI has developed the technology of artificial insemination on natural oestrus and has standardized parasitological techniques for local conditions. However, disease is one of the major problems encountered. Lamb mortality and reproductive problems such as abortions have caused setbacks to the breeding program from time to time. Shortage of infra structure, manpower and forage have limited the number of breeding ewes and rams which should have been larger for the improved accuracy of results.

CONCLUSION

Genetic improvement of sheep for meat production is an important development priority for India. One of the major reasons for the low productivity of Indian sheep is the serious lack of organized efforts for genetic improvement and the lack of a ready source of genes for prolificacy in sheep. The present breeding program is therefore a step in the right direction. Consistently efficient management of the breeding program (animal, people and data management) in the face of varied constraints has been a challenge. Development of a locally-adapted sheep with an average lambing percentage of 140 to 170 per cent would revolutionize the Maharashtra sheep industry. Local shepherds with their ingenious feeding management, would no doubt be able to exploit the fecundity of the sheep to the maximum extent.

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