MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (1): 80-84, 2009
ISSN: 1680-5593

Comparative Economic Returns from Artificial Insemination and Natural Service in Purebred Fat Tailed and Crossbred Romanov Flock

[1]Tecer Atsan, [2]Ebru Emsen, [2]Mustafa Yaprak, [2]Carlos Alcibiades Gimenez Diaz, [2]Ferda Koycegiz and [2]Müzeyyen Kutluca
[1]Department of Agricultural Economics, [2]Department of Animal Science, Ataturk University, 25240, Erzurum, Turkey

Abstract: The objective of this study, was to compare the economic benefits of Laparoscopic Artificial Insemination (LAI) aimed at crossbreeding the native Turkish Fat-Tailed (TNF) sheep with Romanov rams. Net present values of meat income over breeding costs of LAI products and service under Turkish economic and flock management conditions were determined. Data was collected from LAI (n = 240) and traditional natural breeding (n = 240) programs to compare the growing and reproductive performance of crossbred lambs, produced by crossing Romanov sires with TNF dams, relative to purebred TNF lambs. For the TNF flock, using AI service resulted in very positive economic returns (1.6 times greater gross return) in flock situations by higher weaning weight and survival rates for lambs in the first year of the study. In the subsequent year, gross return was 10 times greater for Romanov F1 ewe lambs by higher percentage of animal (60 vs. 25%) lambed at 12 months of age and increased prolificacy (1.8 vs.1.1). In conclusion, laparoscopic artificial insemination to maximize production (e.g., lamb growth and survival, early sexual maturity) can be benefited to TNF sheep raised in eastern Turkey. Producers have implemented crossbreeding programs in an effort to capitalize on heterosis and crossbreeding will almost certainly need to be a bigger part of the LAI due to fat tail of the native sheep breed.

Key words: Gross return, sheep, artificial insemination

INTRODUCTION

Over the past few decades, advances in genetic improvement from the use of artificial insemination in many species of livestock including, cattle and hogs have benefited in significant economic gain. The increase in the gene pool alone will have a long lasting and major influence on these 2 industries. The sheep industry however has not experienced the same influx of superior genetic improvement. For many years, artificial insemination of sheep was thought to be impractical due to the lack of a simple and effective method of artificial insemination. Today however, Artificial Insemination (AI) is gaining acceptance in the sheep industry. In Turkey, nearly 90% of sheep are fat-tailed. Akkaraman and Morkaraman sheep are the most numerous and make up nearly 65% of the total sheep population (Yalcin, 1986; Gürsoy, 2005). These breeds are known by its hardiness and adaptation to marginal conditions that are reflected in its small size, low reproductive efficiency and low milk and wool production. Producers are demanding easy care breeds to produce high quality lambs for improved productivity and competitiveness. Thus, use of The native Turkish Fat Tailed (TNF) breed will require crossing them with the Romanov's to attempt to capture the best characteristics of both types in this zone. Traits contributing to reproduction efficiency include seasonality, fertility, prolificacy, maternal ability, growing performance and lamb vigor. These traits could be combined to be improved thorough the use of Artificial Insemination (AI). Laparoscopic has evolved as one of the least invasive techniques depositing semen in the uterous of the sheep and the fertility may reach up to 70% (Hill *et al*., 1998; Mckelvey *et al*., 1985). Therefore, the introduction of the Romanov breed in order to obtain heterosis for growth and reproductive traits using laparoscopic AI may be an appropriate tool to improve the sheep industry for meat production. The objective of this

Corresponding Author: Ebru Emsen, Department of Animal Science, Faculty of Agriculture, Ataturk University, 25240, Erzurum, Turkey

study, was an evaluation of an assisted reproductive technique (laparoscopic AI) conducted together with an evaluation of crossbred lamb production system compared to traditional breeding system in fat tailed ewes in 2 consecutive years.

MATERIALS AND METHODS

Animals and breeding programs: Experiment was conducted at the Ataturk University, Sheep Research and Application Farm. The genotypes (2-5 years old) involved were Morkaraman (n = 300) and Tuj (n = 180), with the local fat tailed breed of the region. At the beginning of the study the flock was divided into 2 groups, one for crossbreeding with the Romanov rams (n = 5) and the other being bred back to their own breed of ram (n = 8).

Ewes assigned for crossbreeding were included in the Laparoscopic Artificial Insemination (LAI) program due to the inability of short tail Romanov rams lifting the fat tail. Ewes (n = 240) were treated with a vaginal sponge containing 30 mg Fluorgestone Acetate (FGA) (Chronogest, Intervet, Boxmeer, The Netherlands) for 12 days in the breeding season (November). Immediately following the sponge removal ewes received an injection of 600 IU, i.m., eCG. Vasectomized rams were introduced into the herd to better synchronize ewes and to mark ewes as they come into heat at the rate of 5 rams per 100 ewes. The animals were screened for estrus beginning at 24 h after sponge removal and continuing up to 60 h. Screening was performed every day at 9:00 am and 9:00 pm. Animals that did not show any mating marks by 60 h were not inseminated. Semen was collected by artificial vagina and diluted at 32°C by an egg yolk-free extender (Andromed, Minitub, Germany). Marked ewes received an i.v. injection of an anesthetic cocktail containing 2 cc Ketasol (Indus Pharma, Karachi, Pakistan) + 0.04 cc Romphun (Bayer) and were inseminated 54-56 h after sponge removal with freshly diluted semen containing 100×10^6 motile spermatozoa per 0.5 mL. One experienced laparoscopic AI operator performed the inseminations by depositing semen both uterine horns within the 4 h of semen collection. The naturally mated flock (n = 240) were not treated with exogenous hormones as used in a traditional breeding program, in which they were mated with their own breed of ram (ewe: ram ratio = 30:1).

Description of traits and flock management: Traits evaluated were divided into those measured from the start of the breeding season to weaning of the lambs, which was measured at 8 weeks of age. Lambing rate, litter size at birth, number of dam-reared weaned lambs and the weaning weight of lambs were recorded. Total productivity for each ewe entering the breeding flock was calculated at the end of 8 weeks weights for dam reared lambs.

In the subsequent year ewe lambs born from the LAI program and natural mating's were managed together as a single group. Ewe lambs were exposed to rams of their same genotype when they reached 5 months old for 2 months.

Feeding and management: Flock was on pasture during gestation and was given supplemental feed only as needed to meet their nutritional requirements. For 30 days prior to the insemination and for 6 weeks prior to the expected lambing date, ewes were offered a concentrate of (500 g/ewe/day) and dried grass hay at (1.5 kg/ewe/day). Water and mineral licks were available ad libitum. Ewes were treated for parasites, vaccinated against type C and D enterotoxemia and given vitamins A, D and E. Lambing rate was determined on ewes present at the beginning of each lambing season. Approximately, 1 week before parturition, ewes were moved to a building with an elevated wovenwire floor, where they lambed. All lambs were offered a total-mixed creep diet (2.50 Mcal of ME kg^{-1} DM with 16% CP) by approximately 14 days of age. The average amount of creep feed consumed by lambs was estimated at 100 g $days^{-1}$.

Cost evaluation: Sensitivity analyses on the impact of natural mating are reported in Table 1. Cash costs include items like ram price, feed costs (e.g. grain, wheat bran),

Table 1: Sensitivity analyses on the impact of ewe:ram ratio and the initial ram price (USD) on cost per ewe*

Ram price/Ewe:ram ratio	30:1	50:2	75:3	100:4
417	15	21	19	19
Ram maintenance cost				
Wage for shepherd during grazing	13	25	38	50
Winter feeding	79	158	236	315
Veterinary cost	8	17	25	33
Total	100	200	299	398
Ram Maintenance cost/ewe	3	4	4	4
Grand total	18	25	23	23

*Assuming ram value of always 417, herd life of 2 years and an infertility rate of 10% the cost of which is halved when >1 sire is used in the flock

Table 2: Sensitivity analyses on the impact of insemination cost (USD) per ewe

Flock size	30	50	75	100
Synchronization cost	6	6	5	5
Semen cost	6	6	5	5
Surgical supplies	17	17	17	17
Veterinary cost	8	7	7	7
Total	37	36	34	34

non-feed costs (e.g., veterinary charges, wages for hired labour) were included and non-cash costs include items like family labour, capital costs, depreciation costs (equipment and buildings) and other non-market feed costs (e.g., crop residues, household wastes) were not estimated. Sensitivity analyses on the impact of laparoscopic artificial insemination cost per ewes are given in Table 2. Laparoscopic artificial insemination cost did not include either cash or non-cash cost of semen donor rams.

RESULTS AND DISCUSSION

Table 3 represents production parameters of Naturally Mated (NM) or artificially inseminated fat tailed ewes. Four parameters are generally considered important: annual reproductive rate, litter size at birth, survival to weaning age, weaning weight of lambs and total productivity per 100 ewes. In average, fertility was 30% higher in NM fat tailed ewes compared to those inseminated with freshly diluted Romanov semen. The overall total productivity for NM and LAI breeding programs were similar. The importance of input depends on the technologies being evaluated. Romanov crossbred lambs have the advantage of rapid growth and were recorded with a 4 kg higher weaning weight compared to fat tailed native lambs. Borys and Osikowski (1996) evaluated fattening performance and slaughter value in two terminal crosses (Booroola Merino × Polish Merino or Romanov × Polish Merino) and concluded that Romanov sired lambs showed faster growth rate, better feed conversion, better carcass quality and skin quality compared to Polish Merino sired lambs. In another study conducted by Gallivan *et al.* (1993) the fastest preweaning average daily gain was recorded in Romanov crosses relative to Finnsheep. Morever, the fat tailed breed of lambs had the highest lamb mortality (0.10), while that of the Romanov with a first crossbred was the lowest (0.05). The excellent lamb survival rate observed for composite breeds containing Romanov genes has been previously recognized by Ricordeau *et al.* (1977) and Razungles *et al.* (1985).

Many producers fail to realize the full genetic potential of their flocks by marketing lambs at light weights. While, efficiency of gain is greater at lighter weights, total pounds sold dramatically affects gross income and net profit of the sheep enterprise. The market for fat and short tailed lambs are at a price of $US 4 or 6/kg carcass weight, respectively. The price differences between short tailed lambs and fat tailed lambs are about 1.5 times for current meat market in the country. Thus, in summarizing, the cost of natural mating versus artificial insemination, it can be said that even in the short term there is at least a 1.6 times increase in gross return by taking advantage of the higher weaning weight and compatible higher price for Romanov crossbred lambs (Table 4).

Table 3: Production parameters of Turkish fat tailed native sheep and their first cross with romanov

Production parameters in traits	Native fat tailed breed artificially inseminated with romanov	Native fat tailed breed natural mated with own breed of ram
Short-term return on investment of AI		
Annual reproduction rate (%)	60.0	90.0
Litter size at birth	1.3	1.1
Survival 0-4 months (%)	95.0	90.0
Weaning weight of lamb (kg)	20.0	16.0
Total productivity per 100 ewe (kg)	1482.0	1426.0
Long-term return on investment of AI		
Annual reproduction rate of ewe lambs %)	60.0	25.0
Litter size at birth	1.8	1.1
Survival 0-4 months (%)	95.0	75.0
Weaning weight of lamb (kg)	18.0	13.0
Total productivity per 100 ewe (kg)	1847.0	268.0

Table 4: Gross return of natural mating and artificial insemination experiments for fat tailed sheep

	Natural mating	Artificial insemination
Cost of short term program (A1)	230	330
Short term (ST) return (total productivity live weight produced/per 100 ewes) (B1)	1426	1482
Short term meat income (B1/2*X or Y)	2852	4446
Cost of long term program (A2)	230	230
Long term (LT) return (total productivity live weight produced/per 100 ewes) (B2)	134	923
Long term meat income (B2/2*X or Y)	536	5538
Short term gross return (ST-A1)	2622 (1)	8475 (1.6)
Long term gross return (LT-A2)	513 (1)	5308 (10)

X = 4 USD per kg live weight of fat tailed lamb, Y = 6 USD per kg live weight short tailed lamb. Meat income is estimated by assuming carcass weight is 50% dressing percentage of live weight

With their early sexual maturity, it allows them to begin providing economic returns by at least 6 or 7 months of age for the Romanov F1 females. Annual reproductive rate of F1 ewe lambs were recorded at 60%, while it was 25% for native fat tailed ewe lambs. The high net return from advancing age at lambing and increasing litter size along with high survival rates at weaning would even economically justify the utilization of the Romanov breed in any LAI program.

Thus, the long term return on investment of artificial insemination is even more dramatic with 10 times greater gross return (Table 4). Romanov first cross ewes, as were also reported in other studies produced more multiple births and a greater number of lambs born/ewe lambing (fecundity) than in the other breeds. Fahmy (1996) reported that crossbreeding with prolific breeds improves the reproductive performance of the offspring and results in a better performance of the crossbreds than the dam purebreds in terms of ewe lambing rate and fecundity. Gallivan *et al*. (1993) have compared Finnish Landrace and Romanov in a terminal-sire crossbreeding system and reported that Romanov × Targhee ewes have been observed with higher ovulation rate, younger at first estrus and lambing.

The financial costs and benefits associated with the use of artificial insemination in commercial flocks benefits are calculated in terms of net present values after evaluating the discounted value of benefits over two consecutive years. Two breeding strategies are evaluated. With the first, AI is used to produce flock ewes and wethers. The method is likely to be profitable as long as high breeding value rams are available for AI programs with fresh semen and conception rate is around 60% and litter size at birth is average 1.3. For acceptable conception rates, many areas of management, including the ewe's health, successful synchronization, semen handling and quality, the AI technician, stress management after AI and others should be evaluated and controlled carefully. Successful artificial insemination programs involve all of these areas and are linked together like a chain and the failure of any one link will result in lower conception rates. Great success can be realized without a great deal of extra work if attention to detail and good management practices are followed. With the second, NM is used to produce home-bred rams, which in turn sire flock ewes and wethers. This approach is more unlikely to be profitable. The cost of AI per lamb weaned from laparoscopic AI programs is about 46 USD. Benefits exceed this cost for short tail crossbred lambs with higher weaning weights and short tail lamb prices are higher. Second year benefits are increased with higher reproductive performance of F1 ewes. Economically, AI can greatly benefit a breeding program. Used correctly this management tool can open a completely new avenue for the use of genetic gains by utilizing the highly prolific breed of the Romanov. The use of artificial insemination has potential to find a place in the commercial sheep industry in this country mainly because of the economic returns. Results and advancements in this area will benefit sheep producers in their quest to produce those all important economic qualities.

CONCLUSION

Economically, artificial insemination can greatly benefit a breeding program, in which highly prolific breed of the Romanov rams utilized for the use of genetic gains of local breeds with low productivity. The use of laparoscopic artificial insemination has potential to find a place in the commercial sheep industry in Turkey.

REFERENCES

Borys, B. and M. Osikowski, 1996. Two-stage commercial crossing of Polish Merino sheep with prolific Booroola and Romanov rams. II. Fattening performance, slaughter value and skin quality in 1st- and 2nd-stage crosses. Animal Science Paper and Reports, 14 (1): 45-58. http://apps.isiknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=1&SID=V2Ih165l78LNphD71n1&page=7&doc=67&colname=CABI.

Fahmy, M.H., 1996. The Romanov. In: Fahmy, M.H. (Ed.) Prolific Sheep. CAB International, Wallingford, UK, pp: 47-72.

Gallivan, C., R.A., Kemp, Y.M., Berger and L.D. Young, 1993. Comparison of Finnish Landrace and Romanov as prolific breeds in a terminal sire crossbreeding system. J. Anim. Sci., 71: 2910-2918. http://apps.isiknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=8&SID=V2Ih165l78LNphD71n1&page=1&doc=1&colname=WOS.

Gürsoy, O., 2005. Small Ruminant Breeds of Turkey. In: Iniguez, L. (Ed.), Characterization of the Small Ruminant Breeds in West Asia and North Africa, West Asia. International Center for Agricultural Research in the Dry Areas (ICARDA) Aleppo, Syria, 1 (462): 239-416. http://dagris.ilri.cgiar.org/bibdetail.asp?RC=2065.

Hill, J.R., J.A. Thompson and N.R. Perkins, 1998. Factors affecting pregnancy rates following laparoscopic insemination of 28, 447 ewes under commercial conditions: A survey. Theriogenology, 49: 697-709. PMID: 10732078. http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=search&db=pubmed&doptcmdl=citation&term=THERIOGENOLOGY%5Bta%5D%20AND%2049%5Bvi%5D%20AND%20697%5Bpg%5D.

Mckelvey, W.A.C., J.J. Robinson, R.P. Aitken and G. Henderson, 1985. The evaluation of a laparoscopic insemination technique in ewes. Theriogenol., 24: 519-525. PMID: 16726107. http://www.ncbi.nlm.nih.gov/pubmed/16726107.

Ricordeau, G., L. Tchamitchian, C. Lefevre, J.C. Brunel and A. Desvignes, 1977. Productivity improvement of Berrichonnes du Cher (BC) sheep for crossbreeding IV. Pregnancy length and livability of Berrichons, Romanov and crosses F1, F2 and F3 lambs. Genet. Sel. Evol., 9 (1977): 219-239. DOI: 10.1051/gse:1977-0206. http://www.gse-journal.org/index.php?option=article&access=doi&doi=10.1051/gse:19770206.

Razungles, J., L. Tchamitchian, B. Bibe, C. Lefevre, J.C. Brunel and G. Ricordeau, 1985. The Performance of Romanov Crosses and Their Merits as a Basis for Selection. In: Land, R.B. and D.W. Robinson (Eds.). Genetics of Reproduction in Sheep. Butterworths, London, pp: 39-45. ISBN: 0407003029, Book No. 111864.

Yalcin, B.C., 1986. Sheep and Goats in Turkey. FAO Animal production and health paper No. 60, Rome, pp: 168. M-21. ISBN: 92-5-102449-9, http://www.fao.org/AG/AGAINFO/resources/documents/genetics/AH224E.pdf.