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الجمهورية اللبنانية
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مركز مشاريع ودراسات القطاع العام

INSTITUT DE RECHERCHES
AGRONOMIQUES LIBANAIS

Republic of Lebanon
Office of the Minister of State for Administrative Reform
Center for Public Sector Projects and Studies
(C.P.S.P.S.)

SANTÉ ANIMALE

FAO / PNUD / LEB 86 / 003

EFFECT OF CONTROLLED REPRODUCTION
ON

HEALTH AND PRODUCTION OF SHEEP
IN LEBANON

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APRIL 4 1988

SC 1988 / 5

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FAO PROJECT
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INTRODUCTION

Animal production of the developing countries depends on extensive systems especially that of sheep. The rapidly increasing population in these countries is in need of more quality proteins which could be provided by developing the animal industries and sheep production in particular being the preferred livestock animal in most of these countries. The main sheep breed available in Lebanon is the Fat-Tail Awassi breed. This breed is an important domestic animal usually utilized as a triple purpose breed, namely for meat (mutton) milk and wool production. The Awassi sheep are very well adapted to the natural conditions of Lebanon providing a portion of the mutton which is preferred and needed by the Lebanese consumer.

Lebanon imports about 70 - 80% of its animal foods and or their products in order to provide its people with about 80 g. of protein/person/day. About 2/3 of the daily protein consumption is from animal origin and most of the meat consumed is mutton meat. For these reasons and at present, efforts are directed to increase

animal numbers even the topographical conditions of the country does not favor economical feed production, a crucial factor for the achievement of this objective. In addition to feed availability, animal health programs throughout the country, successful animal reproduction techniques and other management controls are important for developing sheep industry. In this study, the effect of controlled reproduction on sheep development and improvement would be emphasized to achieve national goals directed to provide more sheep products for human consumption.

REPRODUCTIVE PATTERNS AND TECHNIQUES

Successful reproduction is important to preserve the animal species and could be achieved by knowing all facts pertaining to the reproductive behavior of the animal. The Awassi sheep are seasonal breeders with majority of estrus (heat period and willingness to accept the male in the act of mating) extending through the late Summer-Fall period. The intensity of sexual activity during this period (very high), provides adequate justification for the planning of breeding operations during late August and September, when day light length is decreasing. Most farmers in Lebanon resort to natural breeding during this period by leaving the rams with the sheep flock thus extending the breeding and lambing durations and adding to the management costs especially through additional care at lambing time. In addition to these extended periods, ewes could

be subjected to reproductive diseases resulting from natural mating which is usually reflected by lower conception and lambing rates, less resistant lambs with poor performance and growth rate. To avoid these reproductive and performance problems, new techniques could be employed to improve sheep production and performance such as

1. Control of Estrus and Ovulation Rate

Estrus and ovulation are well synchronized characteristics in sheep. It could be controlled and inhanced by selection techniques due to the fact, that length of sexual season is heritable (Thimonier et Cognie, 1971). In addition, modification of flock behavior was attained by introduction of vasectomized rams to the flock, and by changing the feeding regime or flushing the ewes before the breeding season to increase the number of the ovulating ovas in an estrus. Also, estrus and ovulation rate were influenced by changes induced on the photoperiod of the environment where animals are present, or by hormonal treatment such as progestagens injections (Lamond and Bindon, 1962) or estradiol treatment (Waite and Foote, 1962) or by hormonal treatment of the feed (Hinds et al., 1964). Currently, the most widely used method of hormonal treatment is the insertion of vaginal sponges (Robinson, 1965) coupled with pregnant mare serum gonadotropins (PMSG) injections. The above mentioned control techniques were highly rewarding and successful interms of more lambs born especially when coupled with artificial insemination (A.I.).

2. Artificial Insemination

Artificial insemination is the method by which male sperms are introduced into the female reproductive tract artificially and without mating. A.I. in sheep proved to be an important factor in improving local species and increasing its production. It rapidly improves flocks by affecting their productivity through the use of selected males. The success of this technique is dependant on utilizing highly selected and improved rams as they will transmit their genetic make up and potential to future generations. Rams selection for this purpose is based on certain criteria such as, the fact that male reproductive organs do not grow proportionately to body weight as do some of the other organs. Also, the sperm producing capacity and the future performance of the young rams could be estimated as a result of testicle measurement taken during the growing period. In general, the size of the testes were highly correlated with sperm production, (Foote, R.H. 1984).

In addition to the above mentioned advantages, A.I. technique utilizes evaluated semen, based on color and volume of ejaculate, and the percentage of progressive sperm motility and number of sperms/ml. This type of evaluation would detect and eliminate infertile rams. Also, and as a result of diluting (rate 1:2 (semen:diluent)) and extending it by a standard extender (consisting of 20ml.egg yolk, 0.8 g. glucose and 2.8 g. sodium citrate dissolved and homogenized in 100ml. distilled water), large number of ewes could be inseminated by this 50% diluted semen. This

dilution would provide about 135 - 140 x 10^6 living sperms in a single dose of 0.2ml. A.I. also allows for the use of fresh diluted semen or frozen semen over longer periods or even after the death of a proven sire.

Successful A.I. program is dependant on proper heat detection which could be attained by checking estrus (about twice a day) with the aid of teaser rams provided with aprons over their bellies to prevent copulation in order to allow use of high quality semen. Females remaining in standing heat on the second day would be reinseminated. The insemination method is as suggested by Abi Saab and Sleiman 1986 using twisted or helicod catheters into the first-second fold of the cervix at 2-2.5cm. The inseminated ewes are usually kept on the inseminating crate with their hind quarters elevated for 3-5 minutes as "Resting time". The importance of the resting time is its effect on conception rate which increased from 75 to 91%, thus meaning that more lambs could be born as a result of this practice.

3. Estrus Synchronization

Estrus synchronization by vaginal sponges is a commonly used technique to improve sheep production especially when coupled with A.I. The progestagen (hormone) is usually introduced by leaving intravaginal sponges impregnated with 60mg. medoxy progesterone acetate over a period of 13 days followed by removal of sponges. Directly after sponge withdrawal, ewes could receive intramuscular

injections of PMSG (500-700 I.U./head). As a result of this practice, most ewes would show heat about 20-48 Hrs. after sponge removal with peak of the flock showing heat by 36 Hrs. In general, most ewes respond and conceive (85%) as a result of this procedure. It was also observed that fertility (number of ewes lambing per 100 ewes inseminated) was about 60% and the prolificacy (number of lambs born per 100 ewes lambing) could be as high as 190% for this fat-tailed breed. In addition, the twinning rate was about 50% indicating that future flock numbers and potentials could be increased and improved by adoption of this program.

Hormonal estrus synchronization could be used even outside the regular breeding season of sheep especially when coupled with PMSG injections. It was observed by Abi Saab and Sleiman that inseminating synchronized ewes either during the third week of April or the first week of June (both inseminations are outside the regular breeding season and either in early or late anestrons) resulted in about 90-100% response to treatment and had a good conception rate of 75-85%. The prolificacy of this treatment was 134-138% and the twinning rate of 25-37.5%. These findings mean that more lambs could be born to the same female during its production life and therefore more supply of mutton to the local market.

IMPORTANCE OF THE CONTROLLED REPRODUCTION TECHNIQUES

Relevance to Lebanon:

Controlled reproduction in sheep is a measure that leads to a rapid genetic improvement in future flocks. It uses highly selected males that produce quality spermatozoa to inseminate large number of females per year. It also allows a detailed hnoledge of the spermatogenic activity of the ram semen which has the major influence, as compered to the ewe, on future sheep numbers and generations. In addition, it allows utilization of highly selected exotic rams to improve local sheep capabilities. The following are information obtained by the author on semen characteristics of the Awassi sheep and that of the Finnlandrace and Finnxtexel sheep and their crosses, in order to be utilized for sheep development programs in Lebanon.

TABLE 1. Semen quality of Awassi, exotic and crossed rams

Aspects	n°. of ejaculate	Volume of semen ±	reaction time ±	progressive motility of	concentration sperm cells/mlx10^9		
rams	used	S.D. ml	S.D. sec.	Fresh semen %	min.	max.	average ± S.D.
Awassi	16	1.07±0.24	40±14.5	88.5	2.4	2.95	2.74±0.1
Exotic	57	1.35±0.68	30±42.7	87.0	1.38	3.05	2.52±0.5
crossed	26	2.30±0.56	55±37.0	90.0	1.45	4.03	2.78±0.6

TABLE 2. Longevity of fresh and diluted semen.

Motility of fresh semen at 24 - 26°C				Motility of diluted stored semen at 2 - 5°C			
Hrs	Awassi	Exotic	crosed	Hrs	Awassi	Exotic	crossed
0	88.5	87	90	6	88	88.5	90
2	83	83	83	12	82	80	85
4	63	75	72	18	80	80	-
6	50	56	-	24	76	78	75
8	45	43	60	30	72	70	70
10	-	37	-	36	70	65	70
12	30	28	35	42	65	60	62
16	12	10	16	48	60	50	60
20	7	5	13	60	48	35	50
24	5	-	10	72	17	15	25
28	-	-	5	84	7	7	15
32			2	96	1	2	12
36			0.2	108	-	-	5

TABLE 3. The effect of semen storage at 2-5°C on the CR of ewes during the breeding period.

Storage duration	0 - 1	8 - 10	22 - 24	32 - 34	42 - 44
Average Motility %	90	83	75	70	62
N° of ewes bred	36	21	12	9	5
N° of ewes conceived	34	19	10	6	2
C R %	94.0	90.4	83.3	66.6	40

TABLE 4. Resting Time Effect On Cenception Rate.

	Minutes			
	0	1	3	5
N° of ewes bred	20	17	22	25
N° of ewes conceived	15	14	20	22
C R %	75	82	91	88

TABLE 5. Evaluation of semen quality of the 4 Awassi rams.

Ram No·	Age/ Year	Number of ejaculates Obtained	Used	Average Volume ml	Concentration X 10^9 cells/ml	Average Motility Fresh	diluted
1	2.5	58	49	1.04	2.91	0.9	0.8
2	1.5	35	31	1.1	2.82	0.9	0.9
3	1	28	25	0.99	2.68	0.8	0.8
4	1	26	25	0.96	2.70	0.9	0.85
TOTAL		147	130	1.08	2.78	0.88	0.83

TABLE 6. Quantitative and Qualitative characteristics of ejaculates obtained during different seasons in Awassi, Finn and Finn Texel rams

Season	Breed	Ejaculate (n°.)	Sperm Characteristics Volume (ml)	Motility (%)	Resistance x 10^3	Concentration x 10^9	Living Sperms (%)	Latent Time (Sec.)
Summer	A	24	0.96	90	18.4	2.78	88.1	31.0
	FT	17	0.76	90	18.0	2.38	79.0	27.0
	F	-	-	-	-	-	-	-
Autumn	A	13	1.12	90	19.4	2.82	86.0	15.1
	FT	30	0.78	87	18.6	2.58	83.2	17.6
	F	5	0.77	90	20.4	2.72	88.8	25.0
Winter	A	12	0.90	85	17.5	2.63	86.7	27.5
	FT	14	0.81	87	19.2	2.72	87.8	25.0
	F	7	0.96	90	21.2	2.72	91.5	24.0
Spring	A	10	1.00	88	17.6	2.73	88.5	18.4
	FT	12	0.77	88	17.1	2.62	87.1	25.0
	F	7	0.94	90	19.0	2.79	88.2	18.2

Averagemdaylight hours, and daily and night temperatures for the various seasons were Summer, 13.1 hours, 30.0°C, 12°C; Autumn, 9.1 hours, 19.0°C, 4.6°C; Winter, 10.4 hours 11.8°C, 1.5°C; and Spring, 14.4 hours, 23.1°C, 8.1°C.

Table 7. Puberty age, weight and semen motility of Awassi and crossbred ram lambs

Breed	Males (N°)	Age at Puberty (Days)	Weight at Puberty (Kg)	Proportion of Adult (%)	Progressive Motility (%)	Sperm Concentration Cell/ml x10^6	Testicular Volume (ml)
Awassi	7	315	56.3	87.5	80	100	570
FTA_{F1}	3	222	52.0	66.7	85	400	635
FTA_{F2}	3	241	42.2	49.1	60	50	440
FA_{F1}	3	240.5	43.5	55.8	75	220	525
TA_{F1}	3	245	53.8	56.0	75	300	600

TABLE 8. Weight and Daily Rate of Gain of Awassi and Crossed Ram Lambs.

Breed	Weight (kg) age (days)				Daily Gain (g)		
	1	56	90	150	56	90	150
A	4.5	14.1	17.6	23.3	171	103	95
TA	4.6	20.6	30.1	37.4	285	278	122
FA	4.4	19.2	24.2	31.6	263	147	124
FTA_{F1}	4.7	20.8	28.6	34.8	288	228	103
FTA_{F2}	4.0	17.0	21.7	28.8	231	140	119

A = Assassi, T - Texel, F = Finnlandrace; Others = crosses

Tabel 9. Age of Puberty and Ejaculate Characteristic.

Breed	Rate of Gain	Age	Weight	Weight of Sire Breed	Motility Sperms	Sperm Cell
	-g-	-days-	-kg-	-%-	-%-	-10^6 cell/m
A	164	315	56.3	87.5	80	100
TA	201	245	53.8	56.0	75	300
FA	163	240	43.5	55.8	75	220
FTA_{F1}	213	222	52.0	66.7	85	400
FTA_{F2}	158	241	42.2	49.1	60	50

See notation above

TABLE 10. Weight and Daily Rate of Gain of Awassi and Crossed Ewe Lambs.

	Age (days)						
Breed	1	56	90	150	56	90	150
	Weight Kg				Daily Gain g.		
A	4.4	13.2	16.8	20.0	157	106	53
TA	4.9	20.9	27.7	30.6	283	200	49
FA	4.6	19.0	25.0	27.3	256	177	38
FTA_{F1}	4.2	16.3	21.6	26.1	215	157	74
FTA_{F2}	4.0	18.2	21.4	25.5	254	93	68

A = Awassi, T = Texel, F = Finnlandrace, TA, FA, FTA, = Crosses

TABLE 11. Age of Puberty as Related to Daily Rate of Gain.

Breed	Rate of Gain	Age at 1st. Estrus	Mating Weight	Weight Dam Breed
	g.	days	Kg	%
A	88	365	36.8	66.5
TA	179	238	47.5	85.9
FA	158	240	42.5	76.8
FTA_{F1}	166	221	41.0	74.1
FTA_{F2}	129	234	34.2	59.8

See notation above.

These findings indicate the relevence of utilizing controlled reproduction techniques in Lebanon as they lead to better flocks. Semen characterization immediately detects infertile rams and therefore an early elimination of these rams from the breeding program could be achieved, thus bringing in more returns to farmers; instead of having to wait until the ewes cycle again to detect whether conceived or not. Through this technique ewes could be mated to a high caliber ram thus minimizing the incidence of return rate, or non conception. Also, as observed A.I. had a positive effect on C.R. rate which increases the possibility of newly born lambs. It also affectd the puberty age, since highly efficient and fertile animals are mated to obtain new generations. The lowered puberty age especially when Awassi is crossed to exotic breeds would lead to earlier reproduction and therefore to more lambs born during the life cycle of ewe. Therefore, an additionsl lambing season could be achieved. The high percentage of twinning rate of sheep on controlled reproduction leads to an increased mutton production in the country. It is estimated that sheep No. in lebanon are about 145×10^3 heads. In addition to this number Lebanon inports $160\text{-}200 \times 10^3$ heads of sheep plus $3\text{-}4 \times 10^3$ tons of mutton per year to meet the demands of the Lebanese consumer. Therefore, improving the twining rate of local sheep especially when coupled with synchronization and breeding outside the season to produce more lambs could help meeting part of this market demand.

Common Reproductive Diseases in Sheep Flocks

In Lebanon there are certain sheep reproductive diseases that could be transmitted by breeding such as:

Brucellosis: A contagious disease, caused by bacteria of the Brucella group and characterized by abortion in the female and infection of the sex glands in the male and infertility in both sexes.

Border Disease: Is a virus disease transmitted through the secretions and excretions of infected animals. Infected females can conceive or may abort or produce infected lambs for many years. Infected ram lambs will have soft and small testicles and can transmit the virus to their progeny through their semen.

Epididymitis: A bacterial disease of sheep (Brucella ovis infection) which impairs fertility in the ram. It causes abortion in the ewe and perinatal mortality in the lamb.

Ulcerative Vulvitis: A disease that leads to ulcerative condition of the prepuce, vulva, penis and skin. In ewes, the symptoms appear as swelling of the vulva and in rams lesions of the glans-penis. The disease is transmitted venerally.

Trichomoniasis: A contageous, venereal, protozoan disease, which is characterized by sterility and abortion. The most common and important sign is infertility caused by early embryonic mortality. It is believed that transmission of this disease occurs during coitus.

Metritis: A problem resulting from a gm negative bacteria, which usually appears as an infection acquired at time of delivery. However, it could be introduced by the male at the time of mating.

The above are the most commong diseases encountered in Lebanon. These diseases lead to tremendous losses in sheep flocks as they lower fertility of the ewes, increase abortions and prenatal deaths. In addition, these diseases affect the estrus cycle and therefore lower the conception rate of the ewe and the possibility for a newly born lamb. Also, treatment for the diseases is needed and therefore additional costs and efforts are required by the farmer.

Controlled Reproduction Versus Natural Mating

The findings presented in this study indicate the following:

1. Natural mating would extend the breeding season in sheep flocks. In other words, lambs will be born over an extended period leading to more management problems (more heating in winter) and less homogenous (in age and weight) lambs.

2. Natural mating could lead to a higher incidence of reproductive diseases. These diseases are usually transmitted by mating and result in lower fertility, prolificacy and number of born lambs. Therefore, the returns to the farmers (No. of lambs sold or kept) would decrease.
3. In many cases natural mating could result in lower growth rate of lambs due to inbreeding or lack of selection or infected lambs thus resulted in less marketable meet.

   However, under this system a farmer could manage larger number of sheep flock but with lower returns.

In contrast, the controlled system of reproduction leads to the following:

1. It detects (at an early age) infertile rams which would be eliminated from the flock.
2. It would detect all cycling ewes (coming into heat) and breed to the selected sire.
3. This controlled system allows for "Resting time" to be effective, thus increasing the conception rate and therefore the number of expected lambs.
4. Other reproductive parameters such as, fertility, prolificacy and twinning are usually improved by this technique leading to more marketable lambs.
5. Through controlled reproduction it would be possible for local sheep to breed at any time of the year. The estrus period in this sheep could be condensed to about 3-days period. Also, their breeding season could be advanced by about 4-weeks. In addition, orphan lambs program could be implemented easily as there would be many available dams.
6. Eliminates risk of reproductive diseases and their detrimental effects on the flock.

In addition to the above advantages, the controlled system could result in the following which could be considered of direct returns to the producer.

A. More lambs born and more marketable mutton.

B. Improved efficiency of feed conversion (mating selected animals or by cross breeding)

C. Provide lambs to market when needed or when prices are high. That is could schedule lamb production when "free" or cheap feed is available

D. Avoid transmittal of reproductive diseases and therefore maintain productivity of flocks

Feasibility of the Controlled System

The controlled system provides:

a. More lambs born, (twining rate and 3 lambings in 2 years) i.e. more returns to the farmer.

b. It eliminates or lowers cost of medication for disease treatment, (savings).

c. Reduces management costs (as lambs are expected within a short period).

d. Reduces mortality of young lambs (increased return)

e. Increased weight of lambs marketed, being resulting from selected animals (i.e. more returns).

However, the farmer that uses this system will incure additional costs such as:

a. Cost of sponges and hormones

b. Inseminators, technicians and equipment required

In any case, expected returns from adoption of this technique would highly increase the income of the Lebanese farmer. However, more returns would be expected if the government (ministry of agriculture) provides the technicians and inseminators to help achieving national goals of higher mutton production to meet the local demand. In addition, it would be possible for each ewe to provide to the farmer about two more lambs during its life cycle, adding to the farmers profits. The Lebanese farmers, seem enthusiastic and have the willingness to adopt this technique because of the expected benefits it provides.

CONCLUSION AND RECOMMENDATIONS

As a result of the facts and findings presented above, it seems feasible and appropriate to recommend that national livestock and sheep development programs in Lebanon, adopt the hormonal synchronization and A.I. programs. If and when these techniques are efficiently utilized, it would be possible to have about three lambings every two years to the same female. This achievement would lead to production and availability of more meat to the local market and to more income to the farmer and more savings by the country. The adoption of these techniques (A.I. and synchronization) would lead to production of healthier animals as it minimizes, or eliminates, the risks of reproductive problems or diseases (due to natural mating) which are reflected in poor performance on part of the ewe, the ram and the young, longer duration for conception as reflected by high percentage of return rate, birth of weak or dead lambs, less animal meat and products availability and lower profits to the farmer. A further improvement in the sheep industry could also be achieved when controlled reproduction is coupled with cross breeding. This means the introduction of new breeds (exotic) to be crossed (artificially) to the fat-tail local Awassi. Only highly selected, prolific, adaptable and disease free exogenous breeds would be used to improve the genetic make up of the future filial crosses which would be reflected in more output.

In conclusion, controling reproduction by synchronization and A.I. and the introduction of high caliber prolific disease free and healthy breeds could lead to more mutton meat production and other animal products (coming from healthy animals) to meet some of the rapidly increasing demand of the Lebanese population for this type of animal proteins and adds to the net income of the farmer.

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