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ORIGINAL ARTICLE

Reproduction and Importance of Reproductive Efficiency in Markhoz (Iranian Angora) Goat

Farzad Abdollahzadeh[1], Shoresh Yousefi[2]
[1]Young Researchers and Elite Club, Boukan Branch, Islamic Azad University, Boukan, Iran
[2]Young researchers and Elite club, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran
Corresponding author: Farzad.Abdolahzadeh@gmail.com

ABSTRACT
A high reproductive rate is a major contributing factor to efficient meat production since only animals which are surplus over replacement needs are available for slaughter. Since meat production is of less importance for the Angora, the relationship between reproduction and efficiency is less direct. However, there are a number of reasons where reproductive rate is important with this animal as well. The most direct of these to the individual producer is that he will have more surplus animals for sale as replacements to other breeders. This is not a net gain to the overall industry, but represents a transfer of funds between producers. However, there are a number of advantages to the industry as a whole: 1) A moderate level of reproduction is necessary to maintain producer herds or national populations. 2) A high level of reproduction permits the industry to respond more rapidly in times of favorable prices or demand for mohair. 3) It contributes to genetic improvement through providing a greater selection differential to an individual producer or to the industry through allowing more animals to be culled. 4) A high reproductive rate contributes to improved mohair production from both a qualitative and quantitative standpoint by reducing or permitting a reduction in the mean age of the flock or population.
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INTRODUCTION

It should be obvious that successful reproduction is necessary to maintain numbers, but this may be more important than is immediately apparent. With the Angora, castrated animals are kept for mohair production. If it is assumed that one-half of the kids born are males, and that most of these are kept for fiber production, then up to one-half of individual or national herds could be males (including castrates). If culling age for the two sexes is similar, the actual percentage of males could theoretically be higher due to a higher loss rate of breeding females. Thus, the net kid crop raised, when expressed as a function of the total adult population, would be approximately one-half the value obtained when expressed as a function of the breeding-age does. Actually, it could be less than this when young or replacement animals are included in the total. Under these conditions, a net kid crop raised of at least 40% of the breeding age does would be required to maintain numbers. A 10% increase in kid crop reared would provide for only approximately 1.5% increase in total numbers (1). This explains the problems encountered in increasing numbers of Angora goats at times of favorable prices. Angora goat numbers may go down at a rapid rate, but they cannot increase at a rapid rate. Good statistics on the kid crop raised are not generally available from mohair-producing areas, but poor reproductive efficiency is known to be a problem. A look at time trends in goats clipped in the world indicates that in times of favorable prices, numbers often increase at about the maximum rate possible. Rapid changes in goat numbers can occur (over the short term) only as a-result of delayed culling, or rapid sell-off of excess animals (especially muttons) for slaughter. Increases in numbers occurred in the periods 1924- 1934, 1952- 1965, and in the decade of the 80's. The rates of increase during the earlier periods were greater than in the decade of the 80's, when prices were considered favorable. One of the more logical explanations for this is that the reproduction rate was greater in these earlier periods. This could very well be explained by a greater labor supply to provide more intense management, and that Angora goats at that time were less highly bred (in respect to fleece

cover), and therefore had higher reproductive rates. In the earlier period (1924-34), no doubt some crossbred types were involved, which would have contributed to higher reproductive rates. Losses due to predation were probably less during this period. In addition to permitting an increase in numbers, a high level of reproduction would also contribute to long-term genetic improvement through providing a larger number from which to select future breeding stock. Most of the true genetic improvement will come from male selection, and a larger number of male kids will provide for greater selection options. A high level of reproduction can contribute to improved quantity and quality of fiber produced in a more direct and more important manner than through its influence on genetic progress. Young animals produce finer quality mohair. They also produce more mohair, except during the first 2 shearings, or at least produce more fiber per unit of body weight maintained, and thus, produce fiber more efficiently. In a similar manner, castrated animals produce more fiber than does. Thus, in a stable population, the percentage of the herd which may be made up of castrates and the age at which both castrates and females can be culled directly influences quantity and quality of mohair produced, which, in turn, is directly related to the rate at which replacements are produced. The sale price of surplus Angora stock is closely related to mohair prices and trends in numbers. This provides a mechanism for producers to gain a reward from improved management practices and to increase kid crop reared during periods of favorable prices. An increased reproductive rate will always tend to increase total income per doe when expressed on a "per head" basis, but marked increases in income per unit of land area or per unit of cost will occur only when mohair prices and the demand for replacements are reasonably favorable. The difference between the two is based on the assumption that larger sized does and, in many cases, a reduced stocking rate and increased feed and labor input are associated with increased kid crops. There have been times in the past, and likely will be in the future as well, in which low prices for surplus animals did not justify these inputs. The major factors contributing to improved kid crops largely result from management. Thus, in tinies of favorable prices these inputs can be maximized, and in times of less favorable prices, these inputs might be reduced. However, in some cases, such as developing young replacement stock, there will be a time-delay before reproduction is affected. Relaxed selection for high fiber production, especially that resulting from extreme covering including the face, will contribute to improved reproductive rate.

Basic Reproductive Phenomena

An understanding of the basic reproductive phenomena of Angora goats is necessary for a discussion of reproductive efficiency or for that matter for overall herd management. The basic reproductive phenomena of the Angora appear to be essentially the same as goats in general. Exceptions to this are their greater seasonality, and the greater stress placed on this breed as a result of the high nutritional demands associated with fiber production. Reproduction in the Angora is a problem area, whereas, many other types of goats are noted for a high level of reproduction.

Age of Puberty

Age of puberty is the initial or minimal age at which the animal becomes reproductively active, i.e., does start ovulating and males start to rut. Angora goats are highly seasonal. They either reach puberty during their first season, at six to eight months, or one year later at approximately 18 months. Individual well-developed kids will reach sexual maturity their first season, but under range conditions, this is often not the case. Even if they do reach puberty, it is not generally recommended that they be bred or used for breeding their first season under range conditions. Individual male kids may be used for light breeding if they are observed to be rutting their first season. No consideration should be given to breeding doe kids unless they are to be raised under unusually good conditions. There is a risk that breeding as kids may result in abortions, which can become habitual. To prevent the occasional breeding of doe kids, they should be separated from male kids or from mature animals during the breeding season. In fact, since kids require or deserve special treatment, they should preferably be managed separately from other age groups throughout their development phase. Under poor range conditions, many does will not breed satisfactorily even as yearlings to kid at two years of age; but this failure is more a result of lack of condition or development and should be viewed as a fault of management.

The Breeding Season

Angora females belong to a group of animals which are referred to as being seasonally polyestrous; that is, they are seasonal breeders, and the females have re-occurring estrual periods during the breeding season if they are not bred. The phenomenon of seasonal breeding is known as photoperiodism, or response to the day/night ratio, as is true of many plants and animals. With Angora goats, the number of hours of darkness appears to be the controlling factor; they start to cycle with reduced day lengths. The goat, especially the Angora, is somewhat unique for domestic animals in that both the males and females

are seasonal. The mating season of the male is easily detected by the characteristic odor and rutting activities. Occasionally, individual males may fail to rut even during the normal breeding season. This is usually explained by their being too young or in poor condition. If this is not the cause of failure to rut, they may be induced to initiate breeding activity by placing them with other rutting males, or with females in estrus. If they continue to show low or minimal interest in breeding, which is not explained by poor condition, they should culled. Goats, including Angora, are also somewhat unique in that the females do not normally start cycling until they are stimulated by the presence of the male. Later in the season, other stimuli can serve this same purpose. The goat is not totally unique in respect to the male effect, but they show this phenomenon to a greater degree, and in a somewhat different manner than other species. Another unique feature is that the females do not all exhibit a silent estrus (ovulation without showing estrus) as do most other ruminants, or if they do, they recycle again within five to seven days instead of one estrous cycle later. The most extensive study of breeding season was done in South Africa (2), which showed does cycling October to February (U.S. equivalent dates) with September as a transitional period. In this country, satisfactory results can usually be obtained from matings starting as early as September, and individual breeders often obtain kids from matings earlier than this. This is greatly influenced by shearing date. Summer kids will occasionally be seen in herds, resulting from winter matings following an early abortion.

Length of Estrous Cycle

The length of estrous is reasonably well documented. Typical estrous cycles of individual does are 19, 20 or 21 days. Two research studies (3, 4) found estrous cycle lengths of 19.5 and 20.6 days, respectively.

Length of Estrus Period

The length of estrus, or the length of time does are in heat, has not been extensively studied in Angora does. However, Van Rensburg [4] arrived at an average length of 22.3 hours, which is shorter than in other species, such as sheep. The duration and intensity of estrus will be longer at estrual periods subsequent to the first and for mature does. This information would be primarily of interest to those persons practicing hand mating or artificial insemination.

Gestation Length

The gestation length of Angora does is well documented, with Shelton [5] reporting an average of 149.2 days, and Van Rensburg [4] was reporting 149.4 days. Ranges as much as 143 to 153 days are reported, but it is difficult to determine if the extreme values should be considered normal. Twin kids are normally dropped approximately one day earlier than singles.

Ovulation or Kidding Rate

Ovulation refers to the release of an egg, or ovum, from the ovary, and sets the upper limit in the number of kids which may be conceived from matings at a given estrus period. An individual doe may ovulate 0, 1, 2 or more ovum. The important contrast in Angora goats is between does which raise one kid or those that raise none, but the potential for "twinning" is rather high. Except for the possibility of identical twins, the ovulation of two ova is necessary for twinning to occur, but does not insure twin births as one of the pair of ova may not be fertilized or the resulting embryo may not survive to term. Identical twinning has not been demonstrated or documented with Angora goats; if it occurs, it is of very low frequency. With other species, such as the sheep, ovulation rate is largely determined by breeding (differences between breeds or strains within breeds), season of the year, and size or conditions of the female. Season of the year is not a particularly important consideration with Angoras, since they are not normally bred outside the fall season, and if breeders wish to do otherwise, this would not be highly successful without the use of hormones or light modification. The expense of doing this would not be warranted for commercial herds. Ovulation rates for the various months from September through December have not been studied, but it is known that the ovulation rate at the second true estrus period of the season is higher than the first [5]. Mating at this second estrus would be expected to result in some increase in level of twinning. Mating at the second estrus may be insured by using sterile males in advance of putting out fertile breeding males or, in some cases, by simply delaying the breeding season until later in the year. Size and development of the doe seem to be the major source of variation in ovulation and kidding rate. In a study by Shelton and Stewart [6], 244 does were slaughtered following the breeding season and the ovulation rate recorded. Of this number, 25 (10.2%) had not ovulated, 170 (69.7%) had single ovulations and 49 (20.1%) had ovulated two eggs. However, the ovulation rate varied greatly between groups of does. The relationship of ovulation rate to size is indirect. The ovulation rate indicates the potential kidding rate, but in practice, the kidding will always be below the ovulation rate. Given good conditions, the ovulation

rate of the Angora may be reasonably high. This may be somewhat dependent on conditions under which the herd has evolved. For instance, limited data from less-developed areas indicate the goats have very low twinning rates. Generally poor feed conditions would not favor a high level of multiple births, and therefore animals developed or maintained under these conditions would not be expected to show a high twinning rate. A low twinning rate of Turkish Angora appears to indicate this. It's the writer's opinion that it is not advisable to actively select for multiple births in Angora goats to be run under range conditions. Stud herd or herds run under farm conditions may well benefit from twinning, but it should be remembered that the target population are those run under commercial conditions. If conditions favor a high level of twinning in the herd, or population, selection for this trait will be automatic. Under adverse range conditions, the contrast is primarily between does which raise 0 or 1 kid. Thus, it appears to be more logical to discriminate against does which fail to raise one kid by reason of abortion or failure to conceive. As applied to a single season, this is automatic, but it is conceivable that producers might find themselves keeping a breeding male out of a doe which raised only one kid in her lifetime. This would almost certainly be a mistake. It is unlikely that failure to reproduce is due directly to specific individual genes, as such genes would be eliminated from the population by natural selection. However, over-emphasis on other traits such as face cover and grease fleece weight (high oil content) which are genetic in origin can adversely influence reproductive rate in an indirect manner. Improvement of reproductive efficiency, including twinning, I should be largely through management practices at times when prices are favorable, and when the additional costs can be justified.

Fetal Development and Birth Weight

In one study, Angora does were sacrificed at various stages of gestation (30-141 days). Fetal weight and crown-rump length (body length from the crown of the head to tail setting) were recorded. The crown-rump lengths are essentially linear. From this relationship, fetal age can be determined either by approximation from the graph, or more accurately by calculation. Fetal weight is highly correlated with age, but this relationship is curvilinear, instead of linear as with fetal length. Actually, the increase in fetal weight is geometric in nature, being very similar to the theoretical curve, assuming a constant and unlimited rate of cell division. If these values are plotted, the rate of growth closely approximates the theoretical until near the end of the gestation period when nutrition or uterine capacity begins to limit growth. The accelerated growth rate of the fetus around 90-100 days indicates increased nutrient demands and coincides with the time that abortions may begin to occur. Normal birth weights for kids are in the range of 5 to 7 Ibs., and kids below this range have low survival rates.

Sources of Loss in Reproductive Efficiency

Kid crops range from 0 to highs of at least 150%. The latter will be limited to small farm herds or intensely managed stud herds. The normal range for commercial herds in Texas tends to be in the range of 40 to 80%. These values are distinctly below that for other types of goats, and can almost certainly be explained by Angoras having been successfully selected for a high level of mohair production, resulting in a situation in which fiber production takes precedence over other body functions such as growth and reproduction. As applied to an individual doe, or even to a herd, a breakdown in reproduction must occur at a specific point as a result of a failure of some process. Thus, it should be useful to investigate the points at which this 1 loss can occur. These may be outlined as follows: 1) a failure to ovulate and/or show estrus, 2) failure of conception, 3) failure of embryo survival resulting in abortion or resorption of the fetus, 4) death losses of kids at or subsequent to birth. It is possible to determine, or document, where losses are occurring, but it may not be feasible for an individual producer to do this. In any case, the results would differ greatly, based on conditions. Data of this nature were tabulated in one study [7]. In this study, the average ovulation rate per doe ovulating was 1.22, suggesting a potential kid crop in this study of 122%. This is not a true estimate of the potential kid crop, as this value was based on does ovulating. In this particular study, the net kid crop raised was 56.4%, which is thought to be indicative of problem herds on the range. In this study 10.7% of the does did not cycle, 12.5% failed to settle, 8.9% lost the fetus(s) and 22.0% lost their kids. Losses at each point were closely related to body weight. It should be pointed out that these data represent problem herds maintained under commercial conditions during the early 70's, when mohair prices were poor and goats received little care. Almost all the indicated losses can be corrected with improved weight and condition of the doe or more intense management during gestation and kidding. Kid crops of at least 100% are theoretically possible under range conditions. Failure to ovulate or cycle is almost totally explained by lack of size and development. This is the case if they are being bred at the appropriate season (fall) and they are sexually mature (at least yearlings). There is simply no alternative to good size and development if good breeding results are to be obtained. This is influenced somewhat by age of the doe. Body weights of yearling does will be concentrated more

at the lower range, resulting in few of them having twin ovulations [8]. Also, the yearlings may breed more readily at a somewhat lower weight than mature does. For reasonable breeding results, yearling does should weigh at least 65 lbs (shorn body weights in the fall) and mature does should weigh 85 lbs. The enormity of the problem is apparent when it is realized that mean body weight of range does is only approximately 65 lbs. The solution is difficult. The high level of mohair production of the Angora goat ensures that this animal is almost always in nutritional stress under typical range conditions. Management practices which contribute to better development are proper stocking rate and other range management practices, parasite control and supplemental feeding. Good management during the post weaning period is often critical for doe kids and can influence lifetime reproductive performance [9]. If optimizing management practices fail to result in an adequate level of reproduction, it may be necessary to relax somewhat the selection for extreme mohair cover or fleece weight. Perhaps the best way to accomplish this is to select for the animal which performs well including raising a good kid crop under the conditions in which the animals are to be maintained.

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