COMBINING OF GENETIC AND REPRODUCTIVE TECHNIQUES TO INCREASE EFFICIENCY OF COMMERCIAL MEAT PRODUCTION

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In the 1970's, every major food crop in the world either leveled off or declined on a per-capita basis. The world population is now increasing more rapidly than the food supply. However, in many countries, costs of producing food are advancing more rapidly than farm prices. Thus, food production will be depressed if efficiency of food production is not increased more rapidly.

Cereal grains are the main commodities shipped from food-surplus countries to food-deficient countries to delay starvation. However, in food-surplus countries, large quantities of grain are fed to livestock and poultry in order to provide a market for the grain. As more grain is exported from these countries, less will be fed to livestock. Consumer demand for meat and other animal products will need to be met by greater production from ruminants on forage, crop residues, and inedible byproducts.

In the United States, there are hundreds of millions of acres of grassland and wasteland that could produce forage for livestock that are now unused or underused. In almost every country, there are feed and forage resources that could be used for meat production without detracting from other food crops by adding sheep or sheep and goats and by increasing their efficiency. Sheep and goats have a higher ceiling on production efficiency than most food crops. They are more efficient meat producers than cattle because of their higher reproductive rates and shorter growing seasons. Because of their higher reproductive rates, they can be improved for any trait, but especially for reproductive rate itself, more rapidly than cattle.

Increase in farm size in the United States has largely ended because it is now hardly possible for the family farmer to control enough land to make a living. Now farmers are finding jobs off the farm as many prefer to live on the farm and to farm part time. They tend to live on smaller farms because land is so valuable that they cannot obtain control of large acreages. Also, they can no longer afford to invest in large intensive operations because of the high risk that farm returns will not increase as rapidly as costs. Also, with grazing animals, small units tend to be more efficient than large units largely because only family labor is used.

Sheep are best suited for increasing net returns on new, small part-time farms and on family farms because meat per acre can be steadily increased without overgrazing and without any production or purchase of grain or concentrates. Increasing lambs per ewe per year has the greatest effect on net income, and forage (land) costs can be held constant by culling more of the lower productive ewes as lambing rates are increased.

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Increased efficiency of sheep (and other livestock) production, through genetic increase in the reproductive rate, could increase meat production from feed materials people cannot eat without increasing demands for such feed. Each year as lambs are increased from a 100-ewe flock by 2 to 5%, the two to five extra lambs would permit the culling of one to three additional ewes thus maintaining the same total equivalent of ewes plus lambs in relation to feed required, but providing three to eight additional animals to sell for meat. These additional market animals could increase net returns from about 20 to 60%. Such an annual increase in efficiency is unheard of in food and fiber production.

In the United States, the reproductive rate (docking in Western states, birth in Eastern states) increased from 0.88 per ewe inventoried in 1940-44 to 0.97 per ewe inventoried in 1977-81 or less than 0.5% per year. However, the increase in the most recent 2 years was from 0.97 in 1980 to 1.01 in 1981. The purpose of this paper is to propose a procedure whereby something like the increase made from 1980 to 1981 can be maintained continually. This is possible as Ercanbrack states in his 1981 progress report—"Percentage superiority of lines selected solely for reproductive criteria, over the unselected controls, is generally increasing at an absolute percentage rate annually of from 3 to 5%." Ercanbrack is not using artificial insemination or embryo transfer, but it is expected that the selection gain from using embryo transfer would only offset the loss from using artificial insemination with frozen semen.

Traditional research of animal breeding, reproduction, and management are giving little if any increases in reproductive rates or in overall efficiency. The reproductive rate of beef cattle in the U.S. has not increased at all in the last 10 years. The reproductive rate of sheep has increased only at the rate of about 0.5% per year over the last 50 years. Now this rate may be increasing to about 1% per year through use of management techniques, breeding more than once per year, breeding ewe lambs, crossbreeding, using the high fertility Finnsheep, artificial rearing, and selection for twinning. Gains from all of this technology may level off between 25 and 50% above the present level of reproduction.

Traditional animal breeding must change to a more active involvement of professional animal breeders in the actual selection process because it will lead to more rapid progress. Small part-time farmers cannot effectively select for increased reproductive rates or be able to even obtain superior rams for this trait. Studies of inheritance, genetic parameters, selection indexes, principles of selection, and of reproductive function have reached the level of diminishing returns. Now genetic, reproductive, and management research and application must be combined to increase the rate of progress in industry far above the present level. In the next 10 years, scientists should get underway with a combination of genetic, reproductive and management techniques to increase the reproductive rate of sheep in industry up to from 2 to 5% per year.

Nucleus flocks of adapted breeds should be established on research stations within ecosystem areas to not only increase the reproduction rate but also to maintain and improve adaptability. Sheep, because of their ability to use low-quality, low-cost, and sparse natural forage must be able to live in the open, often under harsh environments. Therefore, adaptability to the applicable environment is essential for maximum efficiency. Selection within a particular environment is essential for improving both reproductive rate and adaptability although many years may be required to maximize adaptability.
Traits, other than reproductive rate and adaptability, are also important but much less so. Rate of gain, feed efficiency, meat conformation, lower fat content at heavy weights, resistance to disease and parasites, and many others need improvement but are also often quite acceptable now. However, as progress is made toward establishing a more rapid upward trend in lambing rate, selection for other traits along with reproductive rate will be more effective. As the reproductive rate is increased, selection differentials are also increased and generation intervals are decreased.

Embryo transfer, which requires surgery in sheep, may not become practical in production, but it offers great promise in enhancing selection progress. Fertilized ova may be transferred from females superior for reproductive rate to mediocre foster mothers. Thus, selection gains may be more rapid because this will increase the selection differentials on the female side and will decrease the generation intervals. Use of super-ovulation is not favored for this procedure in order to give maximum attention to genetic improvement of the natural ovulation rate.

Artificial insemination (AI) will be most practical in application if done with frozen semen along with synchronized estrus and ovulation. Success of these techniques is now low, but if such success can be given high emphasis in the selection procedure for reproductive rate, it is probable that the success rate can be steadily improved in the nucleus flocks. As the reproductive rate is increased, more adult females can be culled, and these can be the ones that fail from synchronization and AI. It is expected that selection for AI in nucleus flocks should precede practical application by about 10 years.

Artificial insemination promises to be the most effective way of transferring selection gains in nucleus flocks to a large number of small farm flocks. In addition, AI not only gives the small farmer the advantage of superior sires, but also he can now economically use more than one sire so that his best ewes can produce replacements and others can be variously used to produce market lambs, other crossbreeds, or those with special type fleeces. The small farmer will thus have the advantage in flexibility of use of superior sires probably with no added cost as compared to natural mating.

Management practices must be carefully adjusted with the reproductive rate and with the use of reproductive techniques so that mortality, control of parasites, pasture use, and marketing strategy can all be considered in obtaining maximum efficiency.

SUMMARY (1)

In the 1970's, every major food crop in the world either leveled off or declined on a per capita basis because of the increasing world population; but in the United States, there are hundreds of millions of acres of grassland that are wasted that could produce food. Sheep have high potential for most efficient conversion of these and other feedstuffs that cannot be eaten by man to high-quality food and fiber without detracting from any other source of food. Sheep are best suited for increasing net income on new, small, part-time farms and on family farms because meat per acre can be steadily increased without any purchase of outside feed. Increasing lambs per ewe per year has greatest effect on net income, and feed costs can be held constant by culling the less productive ewes as lamb
numbers increase. Selection to increase the lambing rate will be combined with embryo transfer to enhance gains from selection, and artificial insemination will be improved by selection to permit the rapid spread of genetic gains to many small flocks. Genetic progress in reproductive rate and in net income in industry can be increased from 0.5% to 2 to 5% per annum.

R E S U M E N

En los años 70, las producciones de alimentos en el mundo o se equilibraron o declinaron per capita a causa del aumento de la población mundial, pero en los Estados Unidos existen cientos de millones de acres de pastos que se estima que podrían producir alimentos. Las ovejas tienen un alto potencial para una conversión muy eficiente de estos terrenos y de otros alimentos que no pueden ser consumidos por el hombre sin que sean detrados de otro tipo de alimento destinado a los animales. Las ovejas son las más adecuadas para aumentar los beneficios en granjas nuevas, pequeñas, de tiempo parcial y en granjas familiares a causa de que la carne por acre puede aumentar sin necesidad de adquisición de alimentos en el exterior. El incremento de terneros por oveja y año es de un gran efecto sobre el beneficio neto, y los costes del alimento pueden mantenerse constantes disminuyendo las ovejas en producción conforme aumenta la de los corderos. La selección para aumentar el número de corderos por parto puede combinarse con la transferencia de embriones a fin de aprovecharse de las ganancias debidas a la selección, y la inseminación artificial mejorará este objetivo permitiendo una rápida difusión de los avances genéticos a muchos pequeños rebaños. El progreso genético en el tipo de reproducción y en el beneficio neto de industria puede aumentarse de 0,5% a 2-5% por año.