SUSTAINABLE AND CONVENTIONAL GRAZING SYSTEMS FOR BEEF STEERS

V.G. Allen[1,2], J.P. Fontenot[3], W. L. Daniels[1], A.M. Zajac[4],
G.K. Evanylo[1], R.R. Youngman[5] and J. Luna[5,6]
[1]Department of Crop and Soil Environmental Sciences,
[2]Present Address: Department of Plant and Soil Science, Texas Tech University, Lubbock, Texas 79409-2122
[3]Department of Animal and Poultry Sciences,
[4]Virginia-Maryland College of Veterinary Medicine, and [5]Department of Entomology,
Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061
[6]Present Address: Department of Agriculture and Life Science, Corvallis, OR 97331

ABSTRACT
A conventional grazing and crop production system and a sustainable system with integrated grazing and crop production were compared in a farm-scale experiment. The objective was to improve sustainability through improved nutrient management and reduced off-farm chemical use while retaining productivity and profitability. Each system involved 48 steers per year and 32 hectares of crop and pasture land in four replications. Daily gains and final weights were higher ($P<0.05$) for steers in the Sustainable System than the Conventional System but required more supplemental hay feeding. Initially, more forage was harvested from the Sustainable System, but as grazing management improved, more forage was harvested through grazing, and harvested forage became similar between the systems. Pesticide requirements were lower and N fertilizer use was reduced more than 50% for the Sustainable System. The Sustainable System maintained total crop and livestock production potential and was at least as profitable as the Conventional System.

KEYWORDS
Grazing management, forage-livestock systems, alternative agriculture, *Medicago sativa*, beef cattle.

INTRODUCTION
Economic and environmental imperatives clearly necessitate development of farming systems which minimize use of agricultural chemicals while maintaining or increasing crop and livestock productivity. Current livestock production systems in the Southeastern region in the U.S. rely heavily on pastures, harvested forage and grain produced on the farm. Off-farm purchased inputs of fertilizers (particularly N), pesticides, and feeds are used extensively. Various alternative production practices are available, however, to reduce use of these inputs, while maintaining or increasing yield. The Integrated Pest Management (IPM) approach can reduce pesticides for many crops and has resulted in savings of more than $500 million annually in the U.S. (Rajotte *et al*., 1987).

Forages provide the major portion of feed for beef cattle, and play a unique role in designing sustainable and profitable agricultural systems. Their dense canopies and extensive root systems stabilize soils, and reduce soil erosion and movement of chemicals into ground and surface water. Legumes supply N to the soil-plant-animal system while providing high quality forage and reducing fertilizer costs. Profitable systems of grazing management must be developed to promote efficient recycling of nutrients, avoid contamination of surface and ground water, reduce inputs of non-renewable resources and reduce pesticide needs through grazing management strategies.

MATERIALS AND METHODS
This interdisciplinary Farming Systems Project, begun in 1989 at Blacksburg, Virginia, USA, is a replicated farm-scale experiment. It compares a Conventional crop/livestock system with an alternative, Sustainable system to produce finished beef cattle. Results of the first five grazing seasons are presented here. Each system involves 48 steers per year and 32 hectares of crop and pasture land. For the Conventional System, recommended technology and practices in use by progressive producers in Virginia are used. The Sustainable System involves grazing management for pest control and nutrient management as well as improved animal performance.

Conventional System

Pastures: About November 1, weanling steers begin grazing tall fescue *(Festuca arundinacea* Schreb.) stockpiled for winter grazing. Fescue is fertilized with 80 kg N/ha in early August and accumulates (stockpiles) until grazing begins. Grazing continues in this paddock until mid-summer. Hay, previously cut from spring-growth of fescue-red clover (*Trifolium pratense* L.) in a second paddock, is fed if grazable forage becomes limiting. Regrowth of fescue-red clover is grazed while the N-fertilized fescue is stockpiled and until cattle enter the feedlot in mid-October.

Crops. No-till corn (*Zea mays* L.) for silage and alfalfa (*Medicago sativa* L.) for hay are grown for 5-yr. They exchange locations at the end of each 5-yr period. If needed, cattle graze alfalfa, otherwise, alfalfa is a cash crop. Steers can also graze corn-crop residue and the rye (*Scale cereale* L.) cover crop if available.

Sustainable System
Pasture. Stockpiled tall fescue-alfalfa is grazed by steers beginning about November 1. Fescue-alfalfa is not fertilized with N and is stockpiled beginning about September 1. By January, steers are fed hay and/or graze within the crop paddocks. Fescue-alfalfa not needed for grazing is harvested for hay in spring then is rotationally grazed by steers during summer until stockpiling begins.

Crops. The remainder of this system is equally divided into four crop paddocks. Corn for silage is grown in a 4-yr rotation. Corn is followed by wheat (*Triticum aestivum* L.) that is grazed during the following spring. Wheat is followed by millet (*Seteria italica* L) which aids weed control. Millet is grazed or harvested as hay. Alfalfa, planted into millet stubble, is grown for 2 yr. Alfalfa is harvested for hay or is grazed as needed. In October, first year alfalfa is overseeded with rye/wheat to provide additional grazing. Year 2 alfalfa is overseeded with rye for the cover crop for corn establishment.

Steers from both systems are finished on corn silage produced in the respective systems plus supplement (Fontenot *et al*., 1997). Data were analyzed as a randomized block design (SAS, 1985) using a model that tested effects of system, block, year and their interactions.

RESULTS AND DISCUSSION
Final weights of steers at the end of the grazing season were higher for the Conventional System during the first 2 yr (Fig. 1). As grazing management improved, performance of steers on the Sustainable System has been greater during the last 3 yr. Fescue stockpiled with N provided more grazing days during winter than fescue grown with alfalfa. Consequently the Sustainable System required more hay feeding days during late winter. As spring growth of small grains and alfalfa began, the Sustainable System provided more forage for grazing within the cropping areas. The high quality and quantity of these forages and grazing fescue-alfalfa was reflected in improved daily gains of Sustainable System steers. In late summer, the flexibility of the Sustainable System provided more forage for grazing than the Conventional System where hay supplementation was sometimes needed. More total forage was harvested from the Sustainable System during the first years but became similar for both systems during the last 3 yr. Improved grazing management increased forage harvested by grazing rather than by machinery.

More N fertilizer was used every year by the Conventional System than the Sustainable System (Fig. 2) primarily due to use of more alfalfa in

the pasture and crop rotation. However, the Sustainable System has required more K and P fertilizers, thus far, although soil P levels appear higher in the Sustainable System after 5 yr.

Although types of pesticides have differed between the two systems, fewer total inputs of herbicides and insecticides were required by the Sustainable System. Results indicate that grazing strategies on the Sustainable System may reduce populations of potato leafhopper (*Empoasca fabae*) throughout the growing season. A possible explanation is that grazing destroys eggs, which are deposited in alfalfa stems and larger leaf veins. The Sustainable System may also reduce internal parasites in steers. Trichostronngylid egg counts were lower than in steers on the Conventional System, particularly in late spring, but anthelmintics were required in both systems to maintain adequate parasite control.

Results of the first five grazing seasons of this long-term research indicate that integrating cattle grazing with cropping systems can improve nutrient management, reduce inputs of N fertilizers, contribute to pest management for reduced use of pesticides, maintain total crop productivity and improve animal performance. Profitability of the Sustainable System has been at least equal to that of the Conventional System.

REFERENCES

Fontenot, J. P., V. G. Allen, L. L. Scott, D. H. Vaughan, C. A. Laub, and D. B. Taylor. 1997. Corn silage in sustainable and conventional systems for finishing beef cattle. Proc. XIII Int. Grassl. Cong., (In press).

Rajotte, E. G., G. W. Norton, R. F. Kazmierczak, M. T. Lambur, and W. A. Allen. 1987. The national evaluation of extension's integrated pest management (IPM) programs. Public. 491-010. Virginia Coop. Exten.Serv., Blacksburg, VA

SAS. 1985. SAS User's Guide (Version 5 Ed.) SAS Inst. Inc., Cary, NC.

Figure 1
The influence of a Conventional and a Sustainable crop/forage/ livestock system on performance of grazing steers.

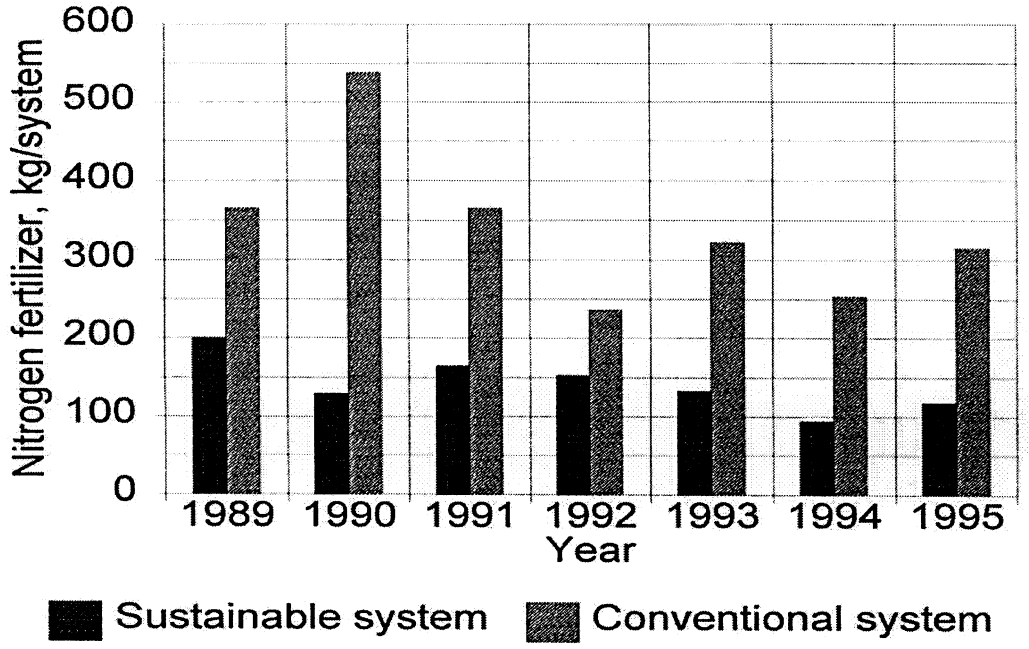

Figure 2
The influence of a Conventional and a Sustainable crop/ forage/livestock system on annual nitrogen fertilizer requirements of the system.