**Sub-Surface Drip-Irrigation for Forage-Livestock Systems**

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## Abstract

A sub-surface drip-irrigation system was established in the summer of 2002. The system consists of eight, 0.25 acre plots, with drip tape laid 9-inches deep on 24-inch centers fed from a metered, central main water supply. Within each plot, water can be supplied on either 24 or 48 inch centers. Water supply is serviced by a central filtration facility. Liquid fertilizer is applied using a venturi injection system. The area was planted with Tifton 85 bermudagrass, using rooted transplants on six-foot centers. During the 2003 season, hay production and animal performance was determined on replicated plots under two levels of irrigation. Irrigation was applied to half of the eight plots at 25% of potential evapotranspiration (PET), with the other four plots receiving 50% PET. Hay was cut from all plots at the end of May, and then from two plots under each irrigation regimen at the end of June, July and August. Hay yields across both treatments were higher in August than June, July or October ($P < .05$), but were higher from the 50% PET plots only in August. Female Boer and Boer x Spanish goats were put on pasture in June at two stocking rates on the remaining four plots. Kids gained better on the low stocking rate (62.0 ±

## Introduction

The availability of water for agricultural irrigation in the Texas Hill Country and Rio Grande Plain is likely to decrease further in the future due to the demands from urban and suburban users, whether from Austin, San Antonio or from smaller urban centers located in the region. A part of this increased water use is due to changes in land use from ranching to suburbanized "ranchettes" surrounding many of the major urban areas in Texas. Many of these land owners wish to raise sheep or goats, primarily for 4-H or recreational purposes. These individuals generally have relatively small acreage but, while often having sufficient capital and interest to invest in newer irrigation technologies, do not have the time or labor to manage conventional sprinkler systems. In addition to our duty to satisfy the needs of these clientele, it is also important for Texas Agricultural Experiment Station scientists involved in Forage-Livestock systems research to fulfill our mission of providing timely and useful information to our traditional clientele. It is, therefore, incumbent on us to develop alternative forage production systems that reduce water usage overall while maintaining profitable yields per acre. While it is currently both economically and technically feasible to grow cool-season forages under conventional overhead irrigation systems, recent advances in drip-tape technology now allow for the use of sub-surface drip irrigation systems in annual forage systems as well as for permanent, warm-season, forages. A very few private individuals in the Rio Grande Plains area have started to embrace sub-surface drip irrigation technology for forage production, but there is almost no independent research to assist the clientele in

decision-making processes. By initiating this project at this time, we intend to become leaders in the field of drip-tape irrigation for forages and thus have a major impact in the development of information for our traditional as well as a non-traditional clientele.

**Materials and Methods**

A sub-surface drip-irrigation system was established within a 2 acre block at the Uvalde Research and Extension Center. The area is sub-divided into eight, 0.25 acre, plots, with drip tape (T-Tape® TSX515) laid 9-inches deep on 24-inch centers with a metered, central main water supply. Within each plot, water can be supplied to each line or to alternate lines thus supplying water on either 24 or 48 inch centers. Water supply is serviced by a central filtration facility, and includes a venturi chemical and fertilizer injector. The area was planted in late June 2002 with Tifton 85 bermudagrass on six foot centers using rooted transplants. Fertilizer is applied according to soil test recommendations and level of N in the forage. Timing and amount of irrigation is based on PET calculations supplied by the Uvalde Center weather station (http://uvalde.tamu.edu/weather/weather.htm). Grass growth rate and forage quality under varying irrigation schedules and animal stocking rates will be determined using conventional techniques in a series of studies over the next several years. Comparisons between drip-irrigation and sprinkler irrigation will be made, using an adjoining area of bermudagrass for the sprinkler irrigated area to avoid problems associated with sprinkler irrigation of relatively small plots. Forage will be harvested for yield and quality determination at intervals that approximate industry standards for hay production. Animal intakes and performance will be measured using conventional fecal-marker based techniques. During periods of grazing, plots will be separated using temporary electric fencing. The current year, 2003, is considered an establishment year, with attempts being made to ensure a weed-free pasture, a fully functional drip and chemigation system, and the delivery of some useful though preliminary data. To this end, flush lines were installed on all plots and data was collected on hay yield and animal performance.

Plots were randomly assigned to be irrigated at either 25% or 50% of PET beginning in mid-March (approximate time of initiation of annual growth). Of the four plots receiving each irrigation treatment, half were designated for haying and the other two designated for grazing. Hay was cut once a month from the middle of May until the end of August. A final cut was made in mid October. Boer and Boer x Spanish nannies and kids were placed on pasture at the end of May after weaning. Nannies and kids were pastured separately. The two pastures stocked with nannies contained 418.3 kg and 233.5 kg total initial weight respectively. Mean animal weight was 46.6 ± 2.12 kg; the two pastures stocked with kids contained 274.6 and 147.4 kg total initial liveweight. Mean kid liveweight was 16.3 ± 1.03 kg. Animals were weighed monthly.

**Results**

A hard, late frost (28.4 $^{o}$F) on March 30, 2003 top-killed the bermudagrass, setting back forage growth severely. Weather data for the period January to October 2003 are presented in Figure 1. Rainfall was below average for the early part of the year (Figure 1), but heavy rains in July and subsequent rain in August and September brought rainfall to normal. Hay was first cut from all plots on May 14$^{th}$. This hay was raked and removed from the plots, but was rained on before it could be baled and weighed. Quadrats (4 x 0.25 m$^2$/plot) cut before hay- making indicated that there was 4500 ± 235 Kg DM/ha of standing forage. Hay yields for the rest of the season are presented in Figure 2. The month by irrigation treatment interaction was significant (P = 0.046). Forage and hay samples were taken for analysis for nitrogen (N) and acid detergent fiber (ADF). These samples are awaiting analysis. Animal production data are presented in Figure 3. The nannies maintained body weight throughout the grazing period. The rate of gain of the two groups of kids was 62 ± 3.51 and 77.0 ± 6.20 g/day for the high and low stocking rate (SR) pastures respectively. All pastures were probably excessively tall for goats at the initiation of grazing resulting in the goats selecting for leaf initially, resulting fairly quickly in a sward with a low leaf to stem ratio and thus reducing voluntary intake. This was probably more marked in the mature nannies. Stemmy material was obviously strongly rejected by all animals. The results suggest that Tifton 85 is a suitable forage for maintaining weight in mature animals, and has the potential for small gains in growing kids. A supplementation regimen is probably required to obtain better gains in order to bring young nannies into breeding condition by early Fall.