



---

# Forage Research in Texas

---

# 1984

## Water Use By Alfalfa for Forage Production

D. J. Undersander and C. H. Naylor

### SUMMARY

Four varieties of alfalfa were grown under a gradient irrigation system during the summer of 1983. There were differences in the water use efficiency (WUE) pounds of dry matter produced per inch of water used among harvests and among varieties within harvests. The range in WUE was from 275 for harvest 1 to 434 for harvest 2. The four varieties of the study showed variation in WUE.

### INTRODUCTION

Increased energy costs have necessitated greater efficiencies in production of irrigated crops. Identification of varietal differences in water use efficiencies (WUE) (forage production/unit of water), could provide economic benefits to the farmer. Additionally, in the High Plains where the Ogalla aquifer is being depleted and, well capacities are declining, the question frequently asked is: how much alfalfa forage can be produced with a given well capacity? The objective of this research is to determine if varietal differences exist in WUE of alfalfa and to develop production functions for alfalfa forage production.

### PROCEDURE

Four varieties of alfalfa (Vanguard, Zia, Cody, Dawson) were planted under a gradient irrigation system in the fall of 1982 with two replicates. Catch cans were placed in the field at 3.3, 13.1, 23.0, 32.8 and 42.7 feet from the line source of sprinklers. Water collected in these containers was recorded after each irrigation or rainfall. Access tubes for measurement of soil water by the neutron moderation method were installed to 6-foot depths adjacent to the catch can.

The plots were irrigated two to three times a week to apply a range of approximately 0 to 10 acre-inches of water per harvest. Forage yields were determined by harvesting strips 3.3 feet wide by 17 feet long. Fifteen parallel strips were harvested across the width of the plot over the range of irrigations.

---

**KEYWORDS:** water use efficiency, irrigation.

## RESULTS AND DISCUSSION

The seasonal forage yields ranged from approximately 500 pounds of dry matter per acre for unirrigated alfalfa to approximately 6,000 pounds for fully irrigated alfalfa. Little or no rainfall occurred during the three harvests reported here, thus the dryland forage yields came almost entirely from stored soil moisture.

All of the response curves indicate high water requirements per pound of forage produced. This was due to the unusually high temperatures and radiant energy that occurred during most of the growing season. The correlation coefficients of the response curves were generally greater than 0.9, indicating a highly linear yield response from water. The data also indicated that, with the exception of one variety-harvest combination, the yield plateau was not reached and, therefore, higher levels of irrigation would have increased yields.

As Table 1 indicates, there was considerable variation between harvests in WUE. Generally, harvest 1, which was harvested July 18 and grew through the hottest temperatures, had the lowest WUE (275 lb/A-in). The second harvest (harvested August 8) had a much higher WUE (434 lb/A-in). The yield response curve would have been higher for harvest 2 except that Zia produced less forage per unit water compared to the first and third harvest while the other varieties produced more.

There also appeared to be some variation in the WUE of the four varieties examined (Table 2) Zia produced more forage per unit of water than the other three varieties in the study. The other varieties were similar in WUE.

In summary, WUE of alfalfa varied among harvests during the growing season of 1983. This was probably related to the temperature under which the crop grew. Additionally, there appeared to be some varietal differences in WUE of alfalfa.



Table 1. Variation in Water Use for Forage Production by Harvest

## Harvest 1

$$\text{Yield (lbs DM/A)}^* = 275 * \text{Water}^{**}$$

## Harvest 2

$$\text{Yield (lbs DM/A)} = 434 * \text{Water}$$

## Harvest 3

$$\text{Yield (lbs DM/A)} = 345 * \text{Water}$$

\* Pounds dry matter of forage per acre.

\*\* Total inches of water per acre available for growth, includes, rain, irrigation and soil water.

Table 2. Variation in Forage Production by Variety.

## VANGUARD

$$\text{Yield (lbs DM/A)}^* = 306 * \text{Water}^{**}$$

## CODY

$$\text{Yield (lbs DM/A)} = 319 * \text{Water}$$

## ZIA

$$\text{Yield (lbs DM/A)} = 375 * \text{Water}$$

## DAWSON

$$\text{Yield (lbs DM/A)} = 345 * \text{Water}$$

\* Pounds dry matter of forage per acre.

\*\* Total inches of water per acre available for growth, includes rain irrigation and soil water.