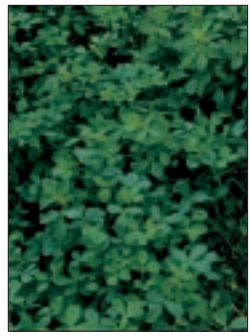
ARIZONA/DELAWARE

High Yield Alfalfa: 24 tons Irrigated... 12 tons Non-Irrigated



By A.E. Ludwick

Some outstanding alfalfa yields have been harvested in research. Here's a look at how those top yields were achieved.

Irrigated Alfalfa

Researchers at the University of Arizona produced up to 24.1 tons/A of alfalfa in a trial at the Yuma Valley Agricultural Center in the 1981-82 growing season. This is a remarkable feat demonstrating the tremendous genetic potential of alfalfa. While alfalfa yields have steadily increased across North America, no one has since reported production near this level.

Top alfalfa yields result from intensive management of a potentially high yielding cultivar grown with high soil fertility. Each ton of alfalfa removes approximately 15 lb of P_2O_5 and 60 lb of K_2O.

One factor leading to yield of more than 20 tons/A is the length of growing season. Ten cuttings were taken during the year-long experiment. Few areas have this advantage. Another way to look at this production is on a per cutting basis. The 24.1 tons/A translates to 2.4 tons/cutting, an excellent season-long average...and attainable in many growing regions.

This experiment was designed to evaluate water and nitrogen (N) use efficiency relationships using sprinkler irrigation for various agronomic and horticultural crops on the Yuma Mesa where citrus was traditionally grown using flood irrigation. Because of the coarse nature of the soil profile (Superstition sand) water rates in excess of 10 A-ft/yr have been used. Alfalfa had been replacing citrus in recent years, but requiring about 12 A-ft with flood irrigation. A summary of the alfalfa portion of the study was presented in: "Alfalfa Yield of 24 tons/A in Arizona Research", *Better Crops with Plant Food*, Winter 1983-84, p. 19.

The two cultivars of alfalfa planted were Mesa-Sirsa, a popular variety among growers at the time, and Lew, a variety that had shown greater nodulation than other alfalfa cultivars. They were seeded at a rate of 20 lb/A on March 4, 1981. Concentrated superphosphate was broadcast and incorporated prior to planting at a rate of 460 lb of P_2O_5/A. Two cuttings were made prior to the initiation of irrigation and N treatments which commenced on June 14. The first cutting for the experiment was taken on July 14. The 10th (last) cutting was taken on July 1, 1982. The N treatments were applied through the irrigation system spaced throughout the season.

TABLE 1. Yield of two alfalfa cultivars (12 percent moisture).

Water, inches/A	Nitrogen, lb/A	Total yield, tons/A		Yield, lb/A-in. water	
		Mesa-Sirsa	Lew	Mesa-Sirsa	Lew
56	346	6.7	5.7	239	204
73	183	5.0	4.9	137	134
73	508	7.7	7.4	211	203
112	114	14.2	15.1	254	270
112	346	16.8	15.9	300	284
112	578	18.0	17.6	321	314
151	183	19.4	18.1	257	240
151	508	24.1	21.5	319	284
168	346	18.3	19.4	218	231

Soil pH 7.9. Available soil P = medium.

A reliable source of water throughout the growing season is fundamental to high yield agriculture in the arid west. Irrigation management, however, is frequently cited as the number one limiting factor in maximizing yields and was a focus of this study. The sprinkler system used was a self-moving lateral system capable of accurately applying 0.2 to 1.4 inches. Following each cutting, the forage was immediately removed from the field similar to a green-chop operation and irrigation initiated the next day. This avoided the dry period following cutting, which is typical of baling operations, and undoubtedly contributed to the high yields.

The highest yields for both cultivars were produced with a combination of 151 total inches of irrigation water plus 508 lb N/A (**Table 1**). Respective hay yields (12 percent moisture) for Mesa-Sirsa and Lew were 24.1 and 21.5 tons/A.

In this experiment, the greatest efficiency of irrigation water was associated with higher yields. Water use efficiency ranged from 134 lb hay/A-inch (4.9 tons/A total yield) to 300 lb or more hay/A-inch for several treatments producing over 15 tons/A total yield.

The fact that N was included as a variable raises a number of questions. It is not a recommended practice to apply such large rates of N to alfalfa, ignoring contributions of N fixation by rhizobia as well as environmental concerns. Supplemental N was required to achieve the highest yield for both cultivars. This is evidenced by the fact that the same irrigation treatment with less N (151 lb/A) produced a lower yield. There were insufficient comparisons to draw any conclusions as to optimum N management to achieve over 20 tons/A. It can be concluded, however, that alfalfa does have the genetic potential to produce very high yields in suitable environments with intensive management.

Non-irrigated Alfalfa

There are a number of reports of non-irrigated production of alfalfa (12 percent moisture) achieving or exceeding 10 tons/A. See **Table 2**.

TABLE 2. Some high yields of non-irrigated alfalfa.

Year	Location	Yield, tons/A
1981-82 (two year average)	Michigan State University	10.0
1982	Michigan State University	10.8
1985	University of Wisconsin	11.5
1987	University of Maryland	11.3
1987	Delaware State College	12.0

The highest reported yield from Delaware State College of 12.0 tons/A was among 34 cultivars that averaged 11.2 tons/A in 1987. Five cuttings were taken, averaging 2.4 tons/cutting for the highest yield which, interestingly, is exactly the yield per cutting reported for the previously discussed Arizona research. A full article is presented in *Better Crops with Plant Food*, Summer 1988, p. 7.

The Delaware trial was grown under high phosphorus (P) and potassium (K) fertility. The site was fertilized with 200 lb/A each of P_2O_5 and K_2O in the establishment year (1985). In subsequent years it was fertilized to replace P and K removed by 10 tons/A of alfalfa, using nutrient removal values of 15 lb of P_2O_5/ton and 60 lb of K_2O/ton. Fertilization was split equally after the first and third cuttings. Boron (B) was also applied at a rate of 2 lb B/A after both harvests. Weeds and insects were controlled as needed.

Yields were limited in 1986 due to dry weather in which only four cuttings were taken. However, the value of high K fertility in drought years was observed. Only 11.9 inches of rain fell from June to October, but the top 10 cultivars in the trial averaged 7.8 tons/A.

Previous cultivar trials in Delaware seldom yielded over 6 tons/A when averaged over all entries. The yield breakthrough came in 1987 with higher fertilizer rates, improved varieties, more intensive harvest schedules, and a complete management system. BC

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