CONCLUSION

These results indicated that the intensity of management anticipated for a seeded site should be considered in selecting a grass species. The selection of a grass species for seeding sites for livestock production is an important decision. The data discussed in this paper indicates that buffelgrass is the most desirable species tested, followed by kleingrass - 75. Both species should be grazed in the spring when protein levels are adequate (above 7%). Both species produce well during the summer months and did not begin to decline in production until December. The low quality of the late winter forage samples indicates a nutritionally critical period if levels of livestock production are to be maintained, especially if early spring calving is planned.

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An Economic And Nutritional Evaluation of Pricklypear As An Emergency Forage Supplement

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ABSTRACT

This investigative research centered on the comparison of supplemental feeding of pricklypear as opposed to conventional hay feeding during drought conditions. Nutritive values of four commonly used supplemental hays were compared to those of pricklypear. Costs of supplementing pricklypear in relation to fuel consumption, protein supplementation, and maintenance of machinery were obtained from ranchers throughout South Texas who have fed pear to their range cattle in the past. Pricklypear supplementation was found to be a rather inexpensive means of feeding and maintaining range cattle during drought conditions - up to 60% less than typical hay feeding programs. This was regardless of weather conditions and month of the year. Pricklypear was found to have extremely low nutritive values as compared to the hay varieties studied.

INTRODUCTION

Pricklypear has been used as livestock feed for more than a century. It usually is considered an undesirable plant on Texas rangelands, but does have some economic value as supplemental forage for cattle during winter and drought periods. Pricklypear has the unique ability of storing water in its flattened fleshy stems. This water reserve enables the plant to withstand long drought periods (Hoffman, 1914). During droughts and range overuse, pricklypear density increases as grass cover lessens. The most common and widespread pricklypears known to Texas ranchers are Engelmann (**Opuntia engelmanni**), Nopal (**Opuntia Lindheimeri**), and Plains (**Opuntia polyacantha**).

Extensive areas of rangeland in South Texas are occupied by dense stands of pricklypear and its net value is controversial (Vallentine, 1971). The pricklypear region par excellence is in Texas, from the Edwards Plateau southward (Griffiths, 1920).

Even relatively inflexible systems of range deferment have resulted in better grass production and higher animal carrying capacity in Texas. In South Texas, orderly programs of range deferment break down during droughts when most pastures should not be grazed at all (Lehmann, 1969). The best native grasses seldom hold more than 2.5 tons of forage per acre at the onset of drought. Purposefully planted and cultivated pricklypear commonly provides 37.50 tons of emergency forage per acre. Cows consume approximately 65.0 lbs. of pricklypear daily (Lehman, 1969). With this known, 93.0 tons of pricklypear on 2.50 acres of land is sufficient for one cow for more than three years. A range stocked with one cow per 15.0 acres should have a year's supply of emergency forage; also, there would be enough pear for quick regrowth if only two percent of the total acreage is in pricklypear (Lehmann 1969). As a forage reserve, pricklypear is more drought resistant than grass and more dependable. Furthermore, pricklypear now is relatively economical to feed. A few South Texas cattle ranchers have been growing substantial numbers of acres (500-625) of pear and harvesting the crop. Af-

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ter burning off the spines, they then process the cactus by chopping (or shredding) it; afterwards, cottonseed, cottonseed meal, or cottonseed cake is added as a protein supplement.

Lehmann (1969) found that one person properly equipped can burn enough pricklypear to satisfy the daily needs of 5,000 yearling steers. The basic pricklypear diet was supplemented with 1.0 lb. of cotton seed meal per animal per day (offered free choice in combination with minerals). Test groups totaling 10,000 steers gained slightly over one pound per day for periods ranging up to 120 days. The total cost of gain was approximately 16 cents per lb. Breeding cattle usually do not add weight on a ration consisting mostly of pricklypear. The vegetative part of cactus can be spiny or spineless and has been widely used for livestock forage in semiarid regions.

Cactus has been described as an unbalanced ration that is low in protein and lipids, but rich in digestible carbohydrates (40% more than alfalfa hay), water, and vitamins (Monjauze and LeHoueron, 1965; and Shoop **et al**. 1977); its digestible energy production per unit of water is high. Chemical analysis and microdigestion trials by Shop **et al.** (1977) indicated that digestibility of pricklypear was equal or superior to that of high quality alfalfa hay. Thus, cactus should provide a good complement to semiarid-adapted nitrogen fixing, high protein trees, like **Leucaena** (Brewbaker and Hutton, 1979), **Prosopis** (Felker and Clark, 1982), and the grasses preferred by cattlemen for livestock forage.

The objective of this study was to: 1) evaluate the nutritional aspects of pricklypear in respect to the needs of pregnant dry cows, 2) determine the economic feasibility of feeding pricklypear as a forage supplement during drought, 3) evaluate the nutritional and economic differences in feeding pricklypear as compared to four different hay varieties.

MATERIALS AND METHODS

A nutritional evaluation of the pricklypear was obtained through analysis from the Texas A & I University Forage Lab. Information was obtained for % dry matter, TDN (total digestible nutrients), crude protein, and digestible energy. These data were then compared to the same type of analysis from four different types of hay: coastal bermudagrass, alfalfa, Kleberg bluestemgrass, and sudangrass hays. These specific hays were chosen because of their popularity or abundant usage among South Texas cattlemen.

An economic evaluation on the supplementation of pricklypear was performed. Costs were determined for the overall supplement program. Expenses were calculated for protein supplementation, fuel (butane), maintenance and depreciation of machinery. A questionnaire was utilized to determine how South Texas ranchers use pricklypear during drought and to procure cost information. From these data, an overall figure for the cost was compared to the costs of supplementing the four previously mentioned hays on a per head, per day basis. Prices for the hays were obtained through published information sources (Anonymous 1980-85).

A students T-test with unknown variences o_1^2 and o_2^2 assumed to be equal was performed to determine any differences between costs of feeding hay vs. pricklypear during drought conditions. The following formula (Bailey, 1959) was used:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$\bar{x}$ = mean

S = estimated standard deviation

RESULTS AND DISCUSSION

The mean values of the dry matter percentages for the different forage supplements were as follows: Kleberg bluestemgrass hay 91.3%; coastal bermudagrass hay 91.0%; alfalfa hay 90.1%; sundangrass hay 88.1%; and pricklypear 17.4% (Table 1).

Table 1. Nutritive values of forage supplements (mean figures)

Supplement	DM	TDN	CP	DE (mcal/kg)
Alfalfa hay	90.1%	58.5%	19.7%	2.62
Coastal bermuda-grass hay	91.0%	53.5%	12.0%	2.36
Kleberg bluestem-grass hay	91.3%	48.4%	6.3%	2.14
Sudangrass hay	88.0%	51.0%	13.7%	2.24
PRICKLYPEAR (Natural)	17.4%	11.0%	1.40%	0.47
PRICKLYPEAR (with protein supplement)	21.0%	13.9%	2.92%	0.56%

Total Digestible Nutrients

Mean values of TDN for the feed supplements were as follows: alfalfa hay 58.5%; coastal bermudagrass hay 53.9%; sudangrass hay 51.0%; Kleberg bluestemgrass hay 48.4%; pricklypear 11.0% (Table 1).

Crude Protein

The crude protein mean values were as follows: alfalfa hay 19.7%; sundangrass hay 13.7%; coastal bermudagrass hay 12.0%; Kleberg bluestemgrass 6.3%; and pricklypear 1.4% (Table 1).

Digestible Energy

Digestible energy mean values of the five forage supplements were: alfalfa 2.62 mcal/kg; coastal bermudagrass hay 2.36 mcal/kg; sudangrass hay 2.24 mcal/kg; Kleberg bluestemrass hay 2.14 mcal/kg; and pricklypear 0.47 DE mcal/kg (Table 1).

Nutritive Evaluation After Protein Supplementation

After the pricklypear (100 lbs.) was supplemented with 4.5 lbs of 41% crude protein cottonseed, the nutritive values changed very little. The following values resulted: the dry matter value of the pricklypear-cottonseed mixture increased from 17.4% to 21.0%. Total digestible nutrients (TDN) had a slight increase from 11.0% to 13.9%. The crude protein rose from the 1.40% level to a value of 2.92%. The added cottonseed also contributed to a slight increase in digestible energy from 0.47 mcal/kg to 0.56 mcal/kg (Table 1).

Table 2. Selected costs associated with feeding pricklypear as a forage (feedlot situation) to beef range cattle.

Expenses	dollars/head/day
cottonseed (any form)	.24
fuel (butane)	.32-.35
maintenance of machinery	
1983	.05
1984	.03-.04
Total costs 1983	.61-.64
Total costs 1984	.59-.63

The protein was supplemented in three basic forms: cottonseed, cottonseed meal, and cottonseed cake. The average costs per metric ton of these three forms differed. When supplementation was necessary and cottonseed was used, the cost per ton was $160.00. The advantage of supplementing with cottonseed was the fat which is derived from the oil of the seed. Cottonseed meal supplement cost $152.00 per ton. The advantage of cottonseed cake supplement was to feed the pricklypear-cottonseed cake mixture to cattle on the ground without having much wasted. The cost per ton of the cottonseed cake was $161.00. Altogether, the average costs per day per cow of cottonseed (in any form) was 24 cents (Table 2).

The fuel source used in the pricklypear feeding operations was butane. The costs of the butane were charged directly to the cattle by the ranchers (for all purposes). Butane cost varied from 64-70 cents per gallon. An average of 1 gallon of butane was sufficient amount of fuel to prepare enough pear to feed two animal units (32¢ -35¢/animal unit). The cactus was burned in windrows to get rid of the spines. The cost of burning ten windrows of cactus was 65-70 cents (1 gallon of butane). Actual costs on a per head per day basis of butane varied from, 32 to 35 cents (Table 2). It generally took one person to haul enough cactus to feed 100 cows each day. In such an operation, there were chopping crews consisting of three people. Each crew was capable of chopping enough pear to feed 650-700 cows daily.

During the first feeding year, maintenance of farm machinery and equipment costs per head, per day were five cents. This included repairs such as welding and truck, tractor, chopper, and burner breakdowns. The following year, costs decreased to 3.0-4.0 cents per head per day (Table 2).

The sum of expenses for pricklypear during 1983 showed that an overall cost of 61-64 cents/head/day was achieved with a slight decrease in 1984 to 59-63 cents/head/day (Table 2). Table 3 shows comparisons of overall costs for feeding pricklypear as a forage as compared to typical hay supplementing on a per head, per day basis. In 1983 the average cost was $1.58/head/day to feed common hays found in the region; supplementing with pricklypear cost was .63/head/day or 60% less. In 1984, cost was $1.84/head/day while feeding hay versus .62/head/day associated with feeding pricklypear (66% less).

Table 3. Overall costs of feeding pricklypear as a forage to beef cattle vs. average costs of feeding common hays.

Year	Dollars/Head/Day
1983	
Hays	1.58
PRICKLYPEAR	.63
1984	
Hays	1.84
PRICKLYPEAR	.62

Table 4. Recommended daily requirements for pregnant dry cows (1000 lbs.) as compared to nutritive values of pricklypear supplemented with 41% crude protein cottonseed.

	DM	TDN	CP	DE (mcal/kg)
Recommended values	20%	9%	.45kg	1.27
PRICKLYPEAR	21%	13%	.77kg	.56

Table 4 shows how the recomended daily nutritive requirements (minimum) compared to the values of pricklypear. With the exception of DE values, it is evident the pricklypear is quite capable of satisfying the daily nutritional needs for pregnant dry cows. In 1983 and 1984 the T-test indicates a high degree of significance (at .05 level), that pricklypear is indeed economically more beneficial on a cost basis as opposed to hay when feeding cattle during drought (Tables 5-6).

Table 5. Results from T-test indicating significance in feeding costs for pricklypear vs. hay during drought conditions.

1983

Source Variation	SS	°Freedom	Mean sq	T val
Hay	.012	2	.006	
PRICKLYPEAR	.0005	2	.0003	4.75*

*Significant at .05

Table 6. Results from T-test indicating significance in feeding costs for pricklypear vs. hay during drought conditions.

1984

Source Variation	SS	°Freedom	Mean sq	T val
Hay	.0042	2	.002	
PRICKLYPEAR	.0014	2	.0007	13.6*

*Significant at .05

SUMMARY

Pricklypear was found to be a feed which possesses quite low nutritive values. When compared to the four hays in the study, it was quite easily outmatched. Because of its extremely high water content, pricklypear's closest competitor in percentage dry matter was 71.0% higher. In crude protein, DE (mcal/kg), and TDN values, pricklypear was also outclassed by its nearest competitor by almost 4 to 1 (Table 1).

Ranchers used 4.5 pounds of 41% crude protein cottonseed per 100 pounds of pricklypear to improve the forage's nutrient quality. Dry matter percentage increased to a point where the range from its closest competitor narrowed from 71% to 67%. Crude protein, DE (mcal/kg), and TDN values of pricklypear were below their nearest competitor by almost 3 to 1 (Table 1).

Protein supplementation with the cottonseed as used by South Texas Ranchers raised nutritive values to a point that the pricklypear provided a forage which quite effectively maintained herds but did not provide a balanced ration (Table 4).

Costs associated with the pricklypear feeding programs proved to be feasible. After harvesting, burning, and processing the pear for the cattle, associated costs were added. The 1983 drought season had an overall cost per head per day of 61-64 cents. This proved to be quite economical compared to the $1.58/head/day figure for feeding hay in 1983. Pricklypear costs during 1984 ran between 59 and 63 cents/head/day. Compared to hay costs of $1.84/head/day, pricklypear fed as a forage again proved to have an economic advantage in 1984. Both seasons provided pricklypear costs ranging from 60 to 66 percent less than conventional hay feeding.

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Effect of Phenology on Total Available Cabohydrates and Crude Protein in Tobosagrass

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ABSTRACT

Total available carbohydrate and crude protein content of tobosagrass (*Hilaria mutica*) was monitored in relation to phenology in the Trans-Pecos region of Texas. The immature leaf, mature leaf, culm elongation, boot, anthesis, seed, and winter dormancy stages were evaluated. Total available carbohydrates only were measured in roots and crowns.

Stems and leaves showed an initial crude protein level of 6.88% which dropped throughout the plant's development to 4.75%. Root and crown carbohydrates showed an initial level of 19%. Shifts in carbohydrates between stems and leaves, roots, and crowns occured throughout the growing season. Root and crown carbohydrates dropped significantly (to 11% and 9% respectively) before and during seed production, but regained early season levels before dormancy.

INTRODUCTION

Non-structural carbohydrates in plants, also known as total available carbohydrates or TAC (Weinman, 1961), are either used as a source of energy, converted to structural form or are stored in the root system for future energy needs. Stored or reserve carbohydrates are essential for the perennial plant to break winter dormancy and initiate the new year's growth. Excessive or repeated removal of new green photosynthetic tissue reduces the plant's ability to produce carbohydrates and forces it to draw on its root reserves. If this continues over a number of years the plant's ability to overwinter and break dormancy is reduced. Eventually the plant may be unable to compete for nutrients and may die (Stoddart, Smith, & Box 1975; Trilica, 1977; White, 1973). Proper grazing management relies on an understanding of the dynamics of carbohydrate storage and protein production in key grazing species. In general protein peaks early and declines as the plant matures. Carbohydrate reserves are usually depleted early and are gradually replenished as the plant matures. Although the general nature of these cycles is recognized the exact nature of this process is unique for each species and is not well documented, especially in the Trans-Pecos.

Tobosagrass is a major component of the vegetation on heavy soils and draw sites in the Trans-Pecos and is an important forage species, especially during its early stages of growth. This study was undertaken in 1985 to monitor total available carbohydrates and protein content in tobosagrass in relation to phenological growth stages. Protein and TAC's were monitored in relation to phenology because we felt that it is important to estimate protein and TAC reserve levels in relation to easily recognizable physical plant characteristics.

Materials and Methods

The study area was located in a draw site on the Del Norte Ranch 12 miles south of Marathon, Texas in a desert grassland association. Average annual rainfall is reported to be 11 inches most of which occurs in the form of summer thunderstorms (SCS, 1972). Precipitation was measured from April to December, 1985.

Tobosagrass collections were made in an ungrazed area from April through December, 1985 during each of 7 identifiable growth stages: immature leaf (less than 3 leaves), mature leaf (3 or more leaves), culm elongation, boot, anthesis, seed, and winter dormancy. Each collection consisted of 5 subsamples of 1 or more entire plants (roots, crowns, stems and leaves).

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