Quality of Kleingrass as Affected by Range Site and Season in The Cross Timbers and Prairies of Texas

by

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ABSTRACT

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Kleingrass, Panicum coloratum, is a warm season perennial bunchgrass introduced from South Africa in 1942. This species is very palatable when grazed by livestock and is distributed throughout Texas. Three samples were collected from each of two sites for a period of eight months from May to December. Samples were then prepared for the chemical analysis of crude protein (CP) and digestible energy (DE). The data were analyzed using least square analysis of variance procedure using computerized statistical analysis system (Barr and Goodnight, 1979).

Acknowledgments

Sincere appreciation and many thanks go to my parents, Mr. and Mrs. Jack Fambro, for making my college education possible. The use of their ranch for the site of my study is also deeply appreciated.

Special thanks go to Dr. M. M. Kothmann who has given freely of his time to help me organize and coordinate my research. The assistance of Ray Hinnant in the laboratory and with the statistical analysis was deeply appreciated. Thanks should also be given to the laboratory technicians in the Range Nutrition Laboratory for their help with the chemical analysis.

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INTRODUCTION

INTRODUCTION

Kleingrass, Panicum coloratum, is a warm-season perennial bunchgrass that was introduced into the United States from South Africa. It is fine-stemmed, leafy, and grows normally to a height of three to four feet at maturity. Kleingrass spreads through tillers, short rhizomes, and may even root at nodes which touch wet soil. The first introduction was in 1942 where it was grown at Texas A & M University. Around 1955 the SCS and Texas Agricultural Experiment Station began field trials throughout Texas. A superior strain known as Kleingrass 75' was released in 1968 after almost fifteen years of research. Kleingrass 75' proved to be the strain that was best adapted to Texas soils. It was also the most desirable for grazing. By 1977 there were 620,000 acres of Kleingrass in Texas that produced almost 11 million dollars in economic returns. By the end of 1980 there are projected to be one million acres of Kleingrass throughout the state.

OBJECTIVES

The objectives of this study were to determine differences in quality of Kleingrass on two different range sites in the Cross Timbers and Prairies of Texas, and to determine the effect of season on the quality of Kleingrass.

LITERATURE REVIEW

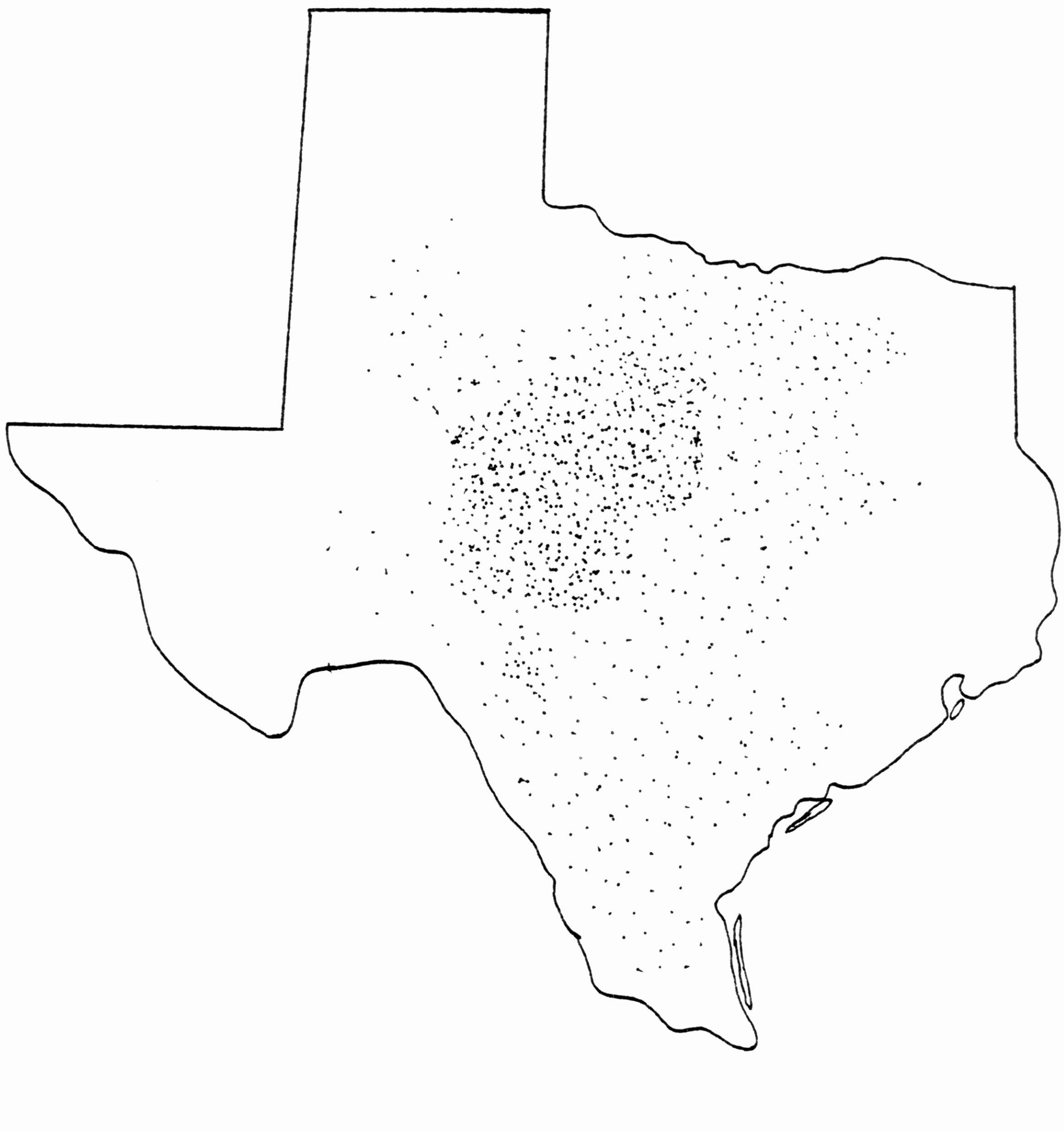
REVIEW OF LITERATURE

Kleingrass is adapted to many different soils and climatic regions which explains its wide distribution throughout the State (Figure 1). The 35th parallel seems to be the northern limitation of Kleingrass mainly because seedlings are not tolerant of extreme cold. Stands that are able to survive the first year following planting have remained in the Panhandle for several years. Kleingrass is grown from the fifty-inch annual rainfall areas of East Texas to the ten-inch rainfall areas of far West Texas (Figure 1). Its southern limit is not specifically known but it does grow along the Coastal Prairie. The main concentration of this species is in the Rolling Red Plains and Prairies and the northeastern portions of the Edwards Plateau (Figure 1).

The major use of Kleingrass is for grazing, but it is also used for hay and seed production. It is considered a multiple use species in that 97.3 percent of the acreage is grazed. Cattle graze 96.9 percent of the total acreage, sheep graze 18.6 percent, goats nine percent and horses 14.7 percent. Deer and other wildlife relish the young tender leaves of Kleingrass. The seed are eaten by dove and quail (Johnson and Engelke, 1978). Kleingrass is harvested for hay in 120 counties throughout the entire state with the majority being in eastern counties. Seed is produced from 3.9 percent of the total acreage located in eighty counties.

A disease known as swellhead has been detected in sheep and

Figure 1 - DISTRIBUTION OF KLEINGRASS IN TEXAS
(Each Dot = 1,000 acres)



goats that graze Kleingrass; however, there have been no detrimental effects to cattle that graze the same ranges. The cause of swell-head has not yet been determined. Approximately three percent of the sheep and goats that graze Kleingrass pastures contract swell-head and about forty percent of these die.

Establishment and management are factors that should be considered when growing Kleingrass (Johnson and Engelke, 1978). It is very important to defer a seeded area for at least six months to allow the stand to become established. Because seedlings develop slowly, it is often necessary to control weeds on newly planted areas. For maximum growth and good forage quality, fertilization is usually necessary. The amount of fertilization required depends on the amount of rainfall. Less fertilization is required in arid and semi-arid regions than in humid regions. Research is needed to determine the effects of seasons and range sites on the quality of Kleingrass.

Forage quality may be estimated by chemical analysis of plants, but it has also been estimated from such attributes as leaf to stem ratios and stages of plant maturity (Lucas, 1963). However, plant quality appears to be derived primarily from protein and digestible energy (DE). Forage quality can be affected directly or indirectly by such things as weather, soil, plant composition, and grazing.

The crude protein (CP) of a plant can give a reliable indication of its value as a feed. CP value is related to digestible protein content (Sullivan, 1963). Ruminant animals need a certain amount of protein to sustain life; however, too much protein is not beneficial. CP content of warm season grasses is lowest in the winter with a peak in the spring, only to drop in the summer and finally rise again in September with the fall rains (Willard and Schuster, 1973). The percentage of CP was highest in the leaf during late May and early June, and declined with advanced maturity (Demarchi, 1973).

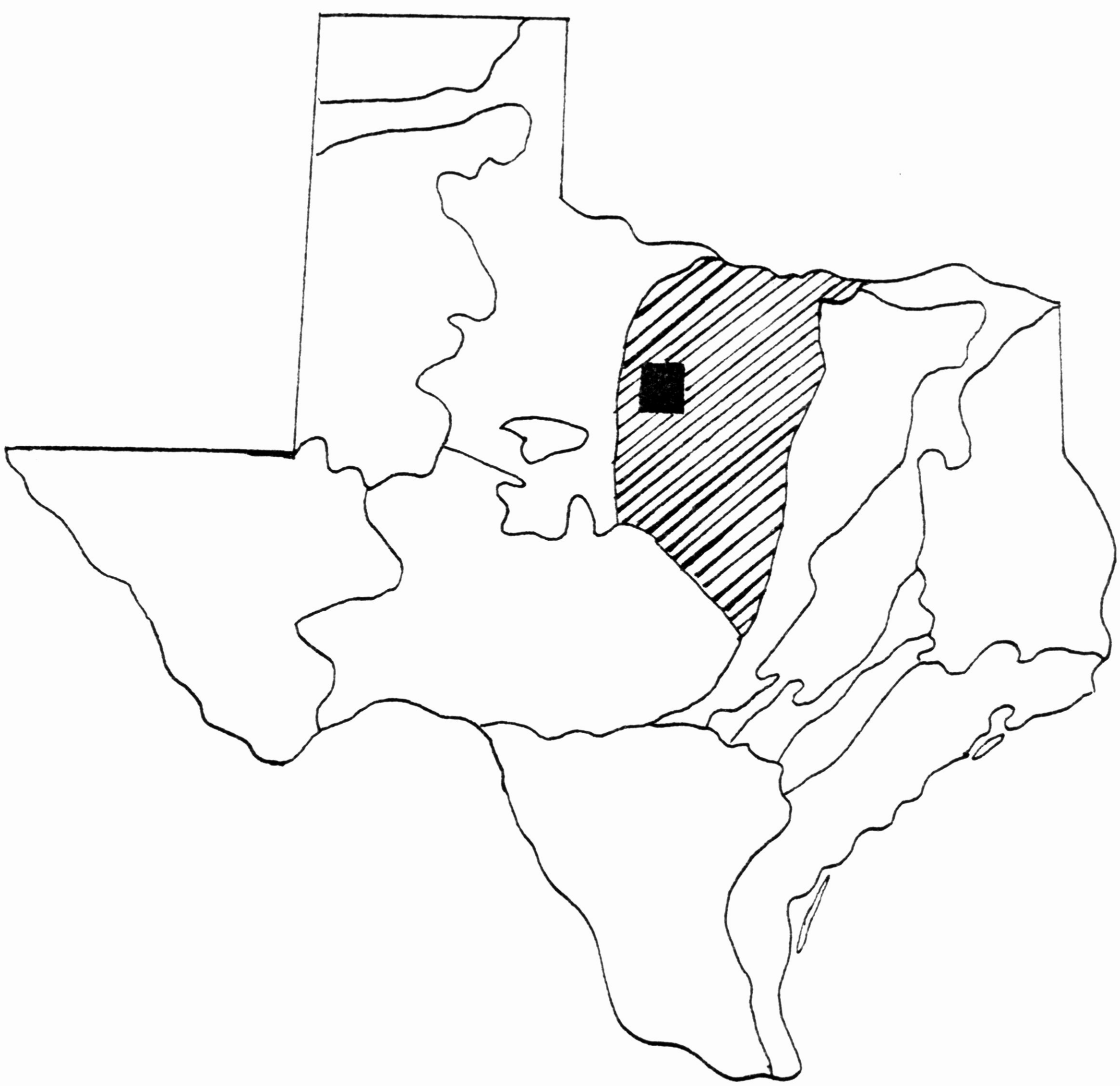
Range sites also have an effect on chemical composition as stated by Heady (1964). A great many studies have shown that plants of the same species grown in different soils often differ in chemical composition and consequently palatability. Studies on various range sites in Utah have shown that protein and several other factors making up chemical composition, varied with soil depth and were more or less palatable to livestock (Cook, 1959). Early research by Stoddart (1941) showed that chemical composition of one species of plant fluctuated on three soil types in Utah. In growth chamber studies Brown (1939) and Bowman and Law (1964) determined that percentages of protein increased as temperature was increased from 60° - 85°F. Extreme temperatures would, however, not follow the trend stated above. Later it was found that increased temperature does not cause increases in nitrogen (crude protein) in all species. Nielsen and Cunningham (1964) found that temperature had little effect on nutrient content.

Although protein is an important component of forage quality, DE is just as important. Digestible energy is a highly significant measure of the nutritive value of grasses. It is also a major basis in the compilation of diets of humans as well as livestock (Swift, 1957). This measure of DE is most important because it provides a common basis for expressing nutritive value (Maynard and Loosli, 1956). With the exceptions of protein deficiencies, the most common nutritional deficiency affecting range animals is DE.

STUDY AREA

Samples were collected from Deep Upland and Sandstone Hills range sites on a ranch in Stephens County, which is in the Cross Timbers and Prairies of Texas (Figure 2). The loamy bottomland site occurs on nearly level to gently sloping lands that are usually adjacent to rivers and streams. The soils on this site are deep and medium to fine textured. The climax plant community for this site consists of tall and mid-grass vegetation. The Sandstone Hills site occurs on hillsides with slopes in the range of five to twenty percent. Sandstone rocks commonly comprise fifteen to thirty percent of the soil surface of this site. Soils of this site are shallow to deep with a fine sandy loam surface The subsoils are mottled or sandy clays containing varying amounts of sandstone. The climax plant community of the Sandstone Hills site also consists of a mixture of mid and tall grasses.

Figure 2 - STUDY AREA: STEPHENS COUNTY LOCATED IN THE CROSS TIMBERS AND PRAIRIES OF TEXAS.



METHODS AND PROCEDURES

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It is important to note that these two sites were in adjacent pastures and were equally affected by environmental factors including grazing from livestock. Three samples were collected from each site on each collection date. Collections were made monthly from May to December of 1979. The samples were divided into categories according to plant parts, which consisted of stems, leaves, and inflorescence. The samples were air dried and ground to pass through a 1 mm screen on an eight inch Wiley mill. Chemical analyses included moisture, organic matter, crude protein, and digestible energy. Moisture content of samples was determined gravimetrically by drying at 105°C to constant weight. Organic matter was determined by ashing in a muffle furnace at 550°C for four hours. Crude protein was analyzed by the Kjeldahl method for total nitrogen (A.O.A.C., 1960). The percentage of crude protein was calculated by multiplying the percentage of Kjeldahl nitrogen by 6.25. Digestible energy was determined by the in vitro digestion techniques used by Tilly and Terry (1963). This was followed by Soest and Wine (1967) neutral detergent extraction to determine the amount of fibrous material left undigested. Residual organic matter was determined by ashing the undigested residue. DE was calculated by multiplying digestible organic matter by 4 kcal/g.

The data were analyzed using least square analysis of variance procedure with computerized statistical analysis sytems (Barr and Goodnight, 1979). The models used for CP and DE are found in Appendix Tables 1 and 2.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

CP of leaves was highest in May when the plants were young and tender. A drop then occurred in June only to rise again in July and August. This is due to the dry period in June and the subsequent rains that followed in the next two months. CP then declines in September and continues to decline over the sampling period (Figure 3). The CP of the stems follows the same pattern as did the leaves (Figure 4). It is important to notice the requirements for a lactating and a dry pregnant cow (Table 1). At first it seems that Kleingrass does not meet these requirements, but this is not the case. Cows graze selectively and pick the better parts of individual plants to make up their diet, thus achieving a diet that is above that required. The only time that this selective grazing may not meet their nutrient requirements is during the period from November to mid-March. That period of time is when supplemental feeding occurs.

DE follows the same decline through the season as did CP with a few minor variations (Figure 5). CP and DE evaluated for range site showed no significant difference between sites when the effects of months and plant parts were masked (Table 2). When plant parts were evaluated leaves proved to be higher in forage quality than stems did (Table 3). The effects of month and site were not considered in evaluating plant parts. It is important to note that forage quality of stems declined more rapidly than it did for leaves (Figure 5).

Figure 3 - CP content of Kleingrass leaves located on a Loamy Bottomland vs. a Sandstone Hills site over an eight month period in the Cross Timbers and Prairies of Texas.

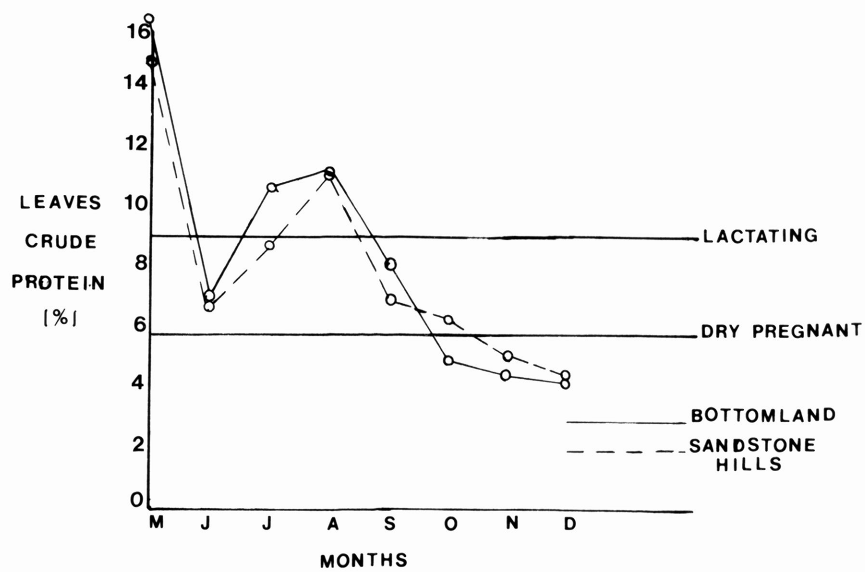

Figure 4 - CP content of Kleingrass stems located on a Loamy Bottomland and a Sandstone Hills site over an eight month period in the Cross Timbers and Prairies of Texas.

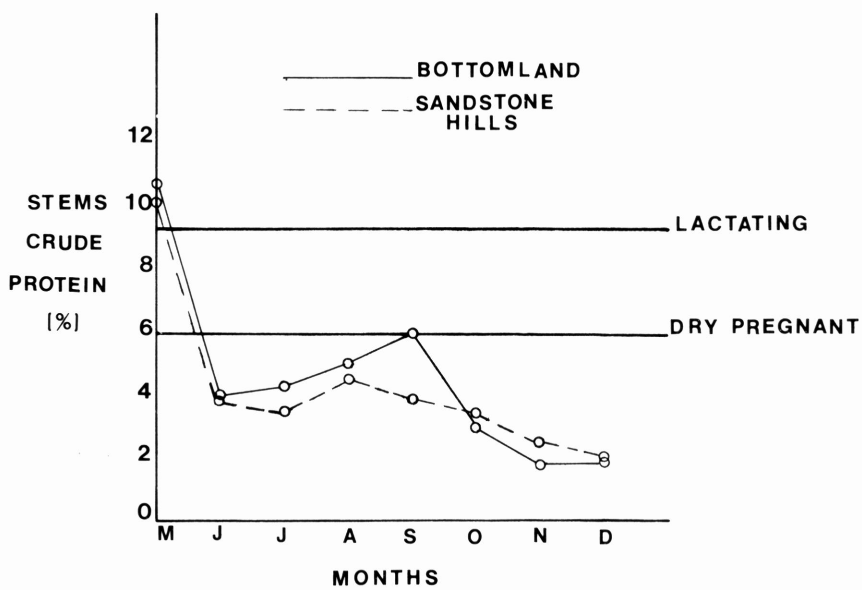

Table 1 - Nutritional requirements for the lactating and the dry pregnant cow.

	Crude protein (%)	Digestible Energy (Kcal/kg)
Dry pregnant cow	5.9	2222
Lactating cow	9.2	2543

Figure 5 - DE content of leaves vs. stems of Kleingrass over an eight month period in the Cross Timbers and Prairies of Texas.

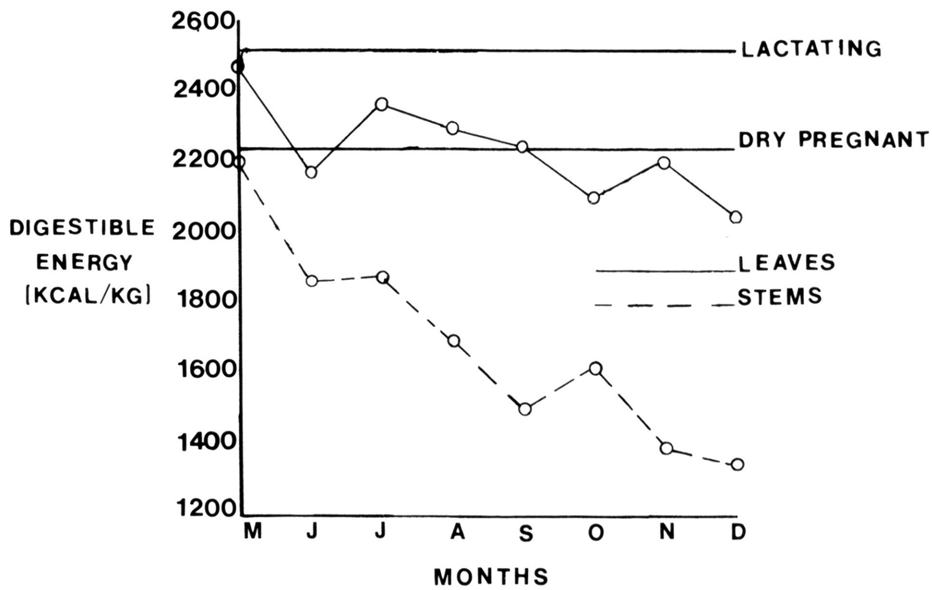

Table 2 - CP and DE evaluated for range site, combining plant parts and also months in the Cross Timbers and Prairies of Texas.

Sites	Protein (%)	Digestible energy (Kcal/kg)
Bottomland	6.60	1971.14
Sandstone Hills	6.00	1973.61

Table 3 - CP and DE evaluated for plant parts, combining sites and also combining months in the Cross Timbers and Prairies of Texas.

Plant part	Protein (%)	Digestible Energy (Kcal/kg)
Leaves	7.99	2247.02
Stems	4.56	1684.88

CONCLUSIONS

CONCLUSIONS

Range sites had no significant effect on forage quality nor were any interactions containing range sites significant. CP and DE differed due to the effect of months. Both decreased in a linear fashion from May to December. Changes in chemical composition of leaves and stems occurred at different rates over the eight month period. CP and DE decreased more rapidly in stems than in leaves. From the results of the study we can see that range site had no effect on forage quality; however, the effect of season and plant part were very significant.

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APPENDIX

Table 1 - Analysis of variance model used to test treatment effects for CP.

Source Of Variance	Degrees of Freedom	Sum of Squares	F Value	Probability >F
Month	7	793.84	27.19	0.0001
Site	1	5.14	1.23	0.2712
Plant Part	1	264.37	63.38	0.0001
Month x Plant Part	6	69.59	2.78	0.0180
Site x Plant Part	7	84.41	2.89	0.0108
Month x Site	1	19.52	4.68	0.0342
Error	66	275.30	____	______

Table 2 - Analysis of variance model used to test treatment effects for DE.

Source Of Variance	Degrees of Freedom	Sum of Squares	F Value	Probability > F
Month	7	3,214,554	11.76	0.0001
Site	1	2,548	0.06	0.8011
Plant Part	1	6,669,013	167.71	0.0001
Month x Site	6	494,856	2.07	0.0708
Month x Plant Part	7	747,321	2.68	0.0180
Site x Plant Part	1	79,705	2.00	0.1624
Month x Site x Plant Part	6	210,349	0.84	0.5416
Error	56	2,226,810	____	________