SIRATRO: A LEGUME FOR SOUTH TEXAS

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ABSTRACT

The value of legumes in a forage program is well established, however; south Texas lacks a summer-growing legume for improved pasture. The objectives of this study were to determine the quality and productivity of Siratro (*Phaseolus atropurpureus* D.C.), a sub-tropical legume species, in south Texas. To determine the effects of inoculation and phosphorus fertilizer, samples were analyzed for crude protein (CP), cell wall content (CWC), and dry-matter yield (DM). Inoculation + 268 lbs/A triple-superphophate increased CP (20.2%) and DM (2,214 lbs/A) and decreased CWC (47.1%) levels. Results of this study indicate that Siratro can be grown in south Texas and has good forage quality and productivity if properly inoculated and fertilized.

INTRODUCTION

Legumes are economical, nutritious, and productive livestock feed. Either alone or in mixtures with grasses, legumes are important in soil conservation and provide a means of increasing forage quality with higher daily gains and higher beef production per acre. Legumes supply nitrogen to the soil through symbiosis with nitrogen fixing organisms and reduce the incidence of grass tetany because of a higher magnesium content than grass. Legumes also lengthen the grazing season, increase cow conception rates, and keeps bulls in better breeding condition (Chessmore, 1979). Because of the long humid summer in south Texas, quality summer pasture is critical if a high level of livestock production is to be maintained. Many legumes native to south Texas are not productive enough for use in pastures (T.E. Fulbright, pers. commun.) and a well adapted summer legume is needed. Siratro, a sub-tropical legume species, was selected for this project. Objectives of this study were to determine effects of phosphorus fertilizer and inoculant on dry matter yield (DM), crude protein (CP) and cell wall content (CWC) of Siratro.

MATERIALS AND METHODS

The study was conducted on the northwest edge of the campus of Texas A&I University, Kingsville, Texas. The study area was comprised of the soil series Orelia fine sandy loam with inclusions of Willacy sandy clay loam.

Siratro was planted in randomized cells (13 x 16 ft) with a 13-ft alley between each cell in two replications. The treatments were: (1) application of 0-46-0 triple - superphosphate at 268 lbs/A, (2) inoculation of the seeds with a "cowpea-type" inoculant, (3) a combination of inoculant and triple-superphosphate at 268 lbs/A, and (4) no treatment (control). Treatments were randomly administered within each replication.

The test area was disked, floated, and each cell hand-raked to insure a clean, weed and clod-free, firm seedbed. Fertilizer was applied broadcast and hand-raked into the soil in those cells receiving fertilizer treatment. Enough cowpea inoculant to thoroughly coat the seed was applied immediately before planting where required. Planting was done in the spring and sampling was delayed until September to allow time for plant establishment.

Sampling was done at bimonthly intervals for 12 months. The samples were clipped by hand using three randomly placed 1.6 by 1.6 ft quadrates in each cell. Plants were clipped to 3.9 inches, dried in a drying room at 105°F and ground in a Wiley mill to pass through a 40-mesh screen. Samples were stored in airtight polyethylene sample bags and analyzed for DM, CP (Harris, 1970), and CWC (Van Soest and Goering, 1970). All assays were run in duplicate. Data were analyzed by analysis of variance procedures using a factorial model with interaction. Means were separated using Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The inoculation treatment did not significantly ($P > 0.05$) increase the protein levels of Siratro above that of the control when values were averaged across sampling dates (Table 1); possibly because competition between native and introduced bacterial strains (Roa, 1976). Phosphorus fertilization significantly ($P < 0.05$) increased protein above the control but not above the level of protein in the inoculated only Siratro. This indicated that phosphorus fertilizer can significantly increase the protein levels of Siratro; as has been reported in other legumes (Jones et al., 1970).

The inoculation plus phosphorus fertilizer (268 lbs/A of (0-46-0) significantly ($P < 0.05$) increased the protein content of Siratro above all other treatments (Table 1). The combination of treatments apparently produce a synergistic affect, compensating for the competition of native rhizobia strains. Proper inoculation and adequate levels of phosphorus are necessary for Siratro to reach high levels of protein. The phosphorus fertilizer stimulates early nodule activity which results in earlier rhizobial production of nitrogen and consequently increased growth and development (Gates, 1970). Siratro had the lowest percent crude protein during the months of August and September (Table 2). Even at lower levels, the CP content of Siratro is well above the generally accepted threshold level of 7% for dry cows. Animal intake and rumen microorganism activity is reduced when the protein content drops below 7%. The percent of CP ranged from a low of 13.2 (control, harvested September 20) to a high of 23.2 (inoculated-fertilized, harvested July 4).

Treatment had no effect (Table 1) on the CWC of Siratro. The CWC was different ($P < 0.05$) (Table 3) among dates, probably due to the physiological development of the legume through the growing season (Minson, 1976). With the exception of the December harvest there was an increase ($P < 0.05$) in CWC with each succeeding harvest (Table 3). The December harvest resulted in a non-significant ($P > 0.05$) drop in CWC, possibly because of a freeze (26.6°F) the day before harvest. The freeze could have lacerated the cell walls, increasing digestibility as determined by the NDF procedure.

The control (1,162 lbs/A) and phosphorus fertilized (1,262 lbs/A) Siratro DM production was higher ($P < 0.05$) than the inoculated only (280 lbs/A) Siratro. The Siratro that received both inoculation and phosphorus fertilizer produced higher ($P < 0.05$) yields (2,215 lbs/A) than all other treatments (Table 4).

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Table 1. Interaction of the control, inoculated, fertilized, and inoculated-fertilized treatments on percent crude protein (CP), cell wall (CW), and dry matter (DM) (lbs/A) at the Texas A&I University Research Compound, Kingsville, Texas.

	TREATMENTS[1]			
Attributes:	Control	Inoculated	Fertilized	Inoculated-Fertilized
Crude Protein	16.6a	17.5ab	18.8b	20.2c
Cell Wall	48.5a	47.7a	47.0a	47.1a
Dry Matter	1162b	780c	1262b	2215a

[1]All values followed by the same letter in the same row are not significantly different at ($P<0.05$) level of probability. Values are averages across all sampling dates.

Table 2. Percent protein (CP) of Siratro as affected by treatment at the Texas A&I University Research Compound, Kingsville, Texas.

	Harvest Dates									
Treatment	9/9	9/23	11/23	12/9	7/4	7/18	8/1	8/15	9/5	9/20
	% Crude Protein[1]									
Control	17.4 b	17.4 b	20.9 a	21.4 a	17.3 b	15.2 c	13.8 de	14.9 d	14.2 de	13.2 e
Inoc.[2]	15.6 cd	16.2 c	20.8 a	21.0 a	19.8 a	18.2 b	16.6 c	15.8 c	14.5 de	14.2 de
Fert.[3]	19.9 c	18.1 d	19.8 c	22.3 a	20.2 b	20.2 b	18.2 d	16.9 e	16.6 e	15.7 e
Inoc.-Fert.[4]	19.3 cd	20.9 bc	21.0 bc	22.3 ab	23.2 a	21.2 bc	18.6 d	19.5 cd	19.4 cd	16.9 e

[1]Means in the same row followed by the same letter are not significantly different at ($P<0.05$) level of probability.

[2]Inoculated. [3]Fertilized. [4]Inoculated-fertilized.

The control plots produced more ($P<0.05$) DM than the inoculated only plots (Table 4). Rao (1976), working with **Arachis hypogea**, indicated that inoculation with **Rhizobia** alone sometimes decreases yields. This may result from competition between the introduced strain of **Rhizobia** and the native strains already present in the soil. This competition reduces the effectiveness of the **Rhizobia** and consequently nodule formation and nitrogen fixation.

The phosphorus fertilizer did not ($P>0.05$) increase DM (1,262 lbs/A) over the control (1,162 lbs/A). However, the inoculated plus phosphorus fertilizer increased ($P<0.05$) DM production to 2,215 lbs/A. Phosphorus is important in the nutrition of nodulated legumes. If phosphorus is limiting, the addition of phosphorus fertilizer can do more to improve DM production than inoculation (Roa, 1976). This appears to be the case with Siratro. Siratro needs both inoculation and adequate phosphorus to reach its production potential in south Texas.

Table 3. Cell wall percentage (CWC) of Siratro as affected by treatments at the Texas A&I University Research Compound, Kingsville, Texas.

	Harvest Dates									
Treatment	9/9	9/23	11/23	12/9	7/4	7/18	8/1	8/15	9/5	9/20
	% Cell Wall[1]									
Control	39.9 c	42.1 c	45.6 b	41.1 c	50.8 a	52.1 a	53.4 a	51.5 a	52.2 a	54.3 a
Inoc.[2]	48.9 bc	44.8 de	45.6 d	42.1 e	47.7 c	50.0 ab	48.5 bc	48.3 bc	51.4 a	51.4 a
Fert.[3]	39.3 g	43.0 f	47.3 d	44.7 e	50.7 b	52.7 a	47.2 d	47.3 d	48.4 cd	49.4 c
Inoc.-Fert.[4]	43.2 d	41.3 e	46.2 c	46.0 c	48.8 b	50.9 a	48.9 b	48.0 b	46.3 c	51.1 a

[1]Means in the same row followed by the same letter are not significantly different at ($P<0.05$) level of probability.

[2]Inoculated. [3]Fertilized. [4]Inoculated-fertilized.

Table 4. Dry matter (DM) production (lbs/A) of Siratro as affected by treatments at the Texas A&I University Research Compound, Kingsville, Texas.

	Harvest Dates									
Treatment	9/9	9/23	11/23	12/9	7/4	7/18	8/1	8/15	9/5	9/20
	Dry Matter lbs/A[1]									
Control	206 c	274 c	899 b	1,286 b	1,505 b	1,526 ab	1,958 a	1,488 b	1,432 b	1,078 b
Inoc.[2]	708 a	787 a	654 a	1,206 a	522 a	792 a	819 a	874 a	842 a	597 a
Fert.[3]	819 ab	726 b	706 b	1,581 a	1,721 a	1,207 ab	1,444 ab	1,479 ab	1,786 a	1,116 ab
Inoc.-Fert.[4]	1,685 ab	2,507 a	2,426 a	1,733 ab	2,190 ab	2,107 ab	2,359 ab	2,205 ab	2,217 ab	1,823 ab

[1]Means in the same row followed by the same letter are not significantly different at ($P<0.05$) level of probability.

[2]Inoculated. [3]Fertilized. [4]Inoculated-fertilized.

CONCLUSION

These results indicate that Siratro is an excellent source of protein ranging from a low of 13.2% CP the last of September to a high of 23.2% the first of July. If the crop is inoculated with cowpea-type **Rhizobia** and adequate phosphorus is available, DM yields ranged from 1,685 lbs/A to 2,507 lbs/A.

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