CARIBBEAN FOOD CROPS SOCIETY

SERVING THE CARIBBEAN SINCE 1963

CARIBBEAN FOOD CROPS SOCIETY

37

Thirty Seventh Annual Meeting 2001

Trinidad and Tobago

Vol. XXXVII

Proceedings of the Caribbean Food Crops Society. 37:300-303. 2001

FERTILIZER EFFECTS ON FORAGE AND SEED YIELD OF GLYCINE (*NEONOTONIA WIGHTII*) IN THE US VIRGIN ISLANDS

Elide Valencia, *Agriculture Experiment Station, RR 2 Box 10,000, Kingshill, VI 00850*
Martin B. Adjei and Jack Rechcigl, Range Cattle and Education Center, Ona, Fl, 33865-9706
Paul Flemming, Agriculture Experiment Station, RR 2 Box 10,000, Kingshill, VI 00850

ABSTRACT: Glycine (*Neonotonia wightii*) is an adapted and productive forage legume for the seasonally dry areas of the eastern Caribbean islands, but lack of seed availability has limited its use. Replicated field studies from September 1999 to April 2001 assessed fertilizer application effects on forage dry matter (DM) and seed yield of glycine var. Cooper. In September 1999, fertilizer treatments (FT) included 0 fertilizer (control), 56 kg ha^{-1} P applied as triple super-phosphate; TSP, 56 kg ha^{-1} potash; K_2O, 28 kg ha^{-1} elemental sulfur; S, and 28 kg ha^{-1} micro-nutrient mixture (2.4% boron, 2.4% calcium, 14.4% iron oxide, 6% manganese, 0.06% molybdenum, and 5.76% zinc). In September 2000, FT included a control, 56 kg ha^{-1} TSP, 56 kg ha^{-1} K_2O, and 28 kg ha^{-1} S. There was no effect of FT on either forage (3,100 kg ha^{-1}) or pod yield (350 kg ha^{-1})in 1999. In 2000, however, there was a trend ($P=0.10$) for higher forage yield for FT. Response to S (forage DM yield of 3,945 kg ha^{-1}) was better than other FT. There were also differences ($P<0.05$) in pod yield. A two-fold increase in pod yield with 56 kg ha^{-1} K_2O (979 kg ha^{-1}) compared to the control (445 kg ha^{-1}) was observed. Excessive rainfall in latter part of 1999 may have affected pod yield. The positive pod yield response to K_2O in March 2001, and yield responses to sulfur justifies further evaluations.

INTRODUCTION

Pasture improvement with use of tropical legumes is a promising technology to augment both quantity and quality of forages on the well-drained calcareous soils of the eastern Caribbean, particularly during the dry season. Research work by Valencia and Adjei (2001) reported that glycine (*Neonotonia wightii*) var. Cooper, a tropical legume, was compatible with grasses (i.e., Mottgrass; *Pennisetum purpureum*) and contributed to increases in yield and nutritive value of the associated forage.

The low availability and lack of seed quality of legume seeds in the Caribbean islands has limited the development of grass-legume pasture based systems. Glycine has potential for an aggressive and dynamic seed production program in the US Virgin Islands. Peak flowering of this legume occurs in December to January to produce a single harvest per year. Seed matures in the early part of the dry season (March-April). According to Paterson (1986) harvesting of glycine can be very flexible as dehiscence (seed shattering) is not a problem as experienced with other legumes (i.e., Siratro; *Macrpotilium atropurpureum*).

Fisher and Thomas (1987) noted that the well-drained calcareous soils of the Caribbean islands have pH ranging from 7.8 to 8.3, low phosphorus (P) content, low to medium potassium (K) contents, medium magnesium (Mg) levels and very high contents of calcium (Ca). Heavy clay soils deficient in P, K and micro-nutrients [i.e., boron (B), molybdenum (Mo), copper (Cu), zinc (Z), manganese (Mn) and iron (Fe)] and their effects on forage and seed yield of Glycine are limited. Both grass and legume forage yield responses to P application rates have not been positive on high pH clay soils (M. Adjei, 2001; personal communication). Research work by Febles et al., (1983) in Cuba reported varying seed production responses of glycine to applications of 70 kg ha^{-1} P $annum^{-1}$. With temperate and tropical legumes, positive forage and seed yield responses to micro-nutrients were reported by Gupta et al.(2001). Little is known on glycine responses to K and Sulfur (S).

The objective of this study was to assess the effects of P, K, S and micro-nutrient applications on forage and seed yield of glycine.

MATERIALS AND METHODS

The experiment was conducted at the Agricultural Experiment Station (AES), University of the Virgin Islands (UVI), St. Croix, between September 1999 and April 2001. The soil was a mildly alkaline Fredensborg clay (fine carbonatic, isohyperthermic, Typic Rendolls, Mollisol) characterized by high permeability and pH of 8.3. At the initiation the experiment in 1999, organic matter was 3.5%, P soluble in $NaHCO_3$ was 20 mg kg^{-1} of dry soil, K was 18.7 mg kg^{-1}, and Ca was above 5,700 mg kg^{-1}. Large between year and within year variation on rainfall was observed. Rainfall was greatest during the months of September to November, with December to March being the driest months (Table 1).

Fertilizer treatments (FT) in September 1999 consisted of 0 fertilizer (Control), 56 kg ha^{-1} P as triple superphosphate; TSP, 56 kg ha^{-1} K; K_2O, 28 kg ha^{-1} elemental sulfur; S, and 28 kg ha^{-1} micro-nutrient mixture (2.4% boron, 2.4% calcium, 14.4% iron oxide, 6% manganese, 0.06% molybdenum, and 5.76% zinc). In September 2000, FT included a control, 56 kg ha^{-1} TSP, 56 kg ha^{-1} K_2O, and 28 kg ha^{-1} S. The micro-nutrient mixture was not available for use on 2000. A pure stand of glycine var. Cooper previously used as a nursery since 1997 was rehabilitated (hand weeding) in 1998 and used for the study. The experimental design was a randomized complete block. The FT were randomized within each of four blocks.

All FT were broadcast applied on the 16 September 1999 and on the 21 September 2000 to take advantage of moist-rainy conditions. After un-interrupted growth for 18 wks, a 0.5 x 2-m area in each FT was clipped to ground level to determine dry matter yield (DMY) and seed yield on 14 March 2000. Dry pods were removed manually from clipped area and weighed. Forage was forced air-dried at 60 C to determine DM. A 100-seed dry weight was also taken. Experimental plots were clipped twice during the dry season and also prior to re-application of FT (every 8 wks).

In year 2, FT were re-applied on the same plots, except for micro-nutrients on 21 September 2000. Forage yield and seed harvest were determined on 7 March 2001.

All data were analyzed using the general linear models procedure of SAS (SAS, 1989). Years were analyzed differently because FT differed in the 2 years. Comparisons of FT were made using Fisher's Least Significant Difference Test (LSD).

RESULTS

Rainfall in the latter part of 1999 differed from 2000 (Table 1). September-December was wetter than the same period in 2000 (Table 1).

Dry matter harvested on March 2000 was similar ($P=0.18$) for all FT and averaged 3195 kg ha^{-1}. Pod yield and 100-seed weight were not affected by FT (Table 2). Pod yield for all FT, however, were much lower than those observed the following year. Rainfall in December 1999 (149 mm) was much higher than the norm (Table 1) and may have affected glycine flowering and pod development.
There was a trend ($P=0.10$) for higher DM yield on March 2001. The highest DM was recorded for S (3945 kg ha^{-1}). This increase, however, was only slightly higher than the control (3550 kg ha^{-1}). Fertilizer treatment with K_2O was similar to the control. Earlier work by Gutteridge and Whiteman (1978) reported that they were successful in increasing the botanical composition of legume with application of K from 75 to 100 kg ha^{-1}.

There was a significant effect ($P<0.05$) of FT on pod yield on March 2001. A two-fold increase on pod yield with applications of either K_2O (979 kg ha^{-1}) or S (895 kg ha^{-1}; Table 3) were recorded. Moron and Risso (2001) reported a positive response of the legume white clover (*Trifolium repens*), particularly legume yield at a rate of 25 kg ha^{1}.

Pod yield with applications of TSP (528 kg ha^{-1}) was not different from the control (445 kg ha^{-1}). Febles et al. (1983) assessed the effect of P fertilizer application (70 kg ha^{-1}) on heavy clay soils and noted that glycine seed formation did not show any response to P dressing irrespective of years. There was also no effect of FT on 100-seed weight of glycine in March 2001.

CONCLUSIONS

Results of this study suggests that there are no benefits to P fertilization of glycine at 56 kg ha^{-1}. It is possible that the P is tied in the clay soils and not available for plant use. There was, however, potential for using elemental S and K for increasing glycine forage and seed yield, respectively. Future studies should include varying rates increasing K and Sulfur to measure the response curve and assess the feasibility of fertilizer use.

ACKNOWLEDGMENTS

The authors express their appreciation to Mr. Antonio Rodriguez and Louis Lawrence for establishment and sampling of experimental plots. Research was sponsored by USDA special grant 99-05086 administered by the Caribbean Basin Advisory Group TSTAR.

REFERENCES

Fisher, M.J., and D. Thomas. 1987. Environmental and physiological limits to tropical forage production in the Caribbean basin. pp. 3-19. In: J.E. Moore, K.H. Quesenberry and M.W. Michaud (eds.) Proc. of a workshop on Forage-livestock research needs for the Caribbean basin. Tampa, Fl. 9-12 February, 1987.

Febles, G., J. Perez, and C. Padilla. 1983. The effect of time of application of phosphoric fertilizer on *Neonotonia wightii* seed production. Cuban J. of Agric. Sci. 17 (2):183-190.

Gupta, U., F.A. Monteiro, and J.C. Werner. 2001. Micro nutrients in grassland production. pp. 149-156. In: Proc. of the XIX Int. Grassl. Cong. 11-21 February 2001. Sao Pedro, Sao Paulo, Brazil.

Gutteridge, R.C., and P.C. Whiteman. 1978. Potassium fertilizer studies on *Brachiaria mutica-Centrosema pubescens* pastures grown on soils derived from coral limestone, Malaita Solomon Islands. I. Effect of rates of potassium on yield and botanical composition. Trop. Agric. (Trinidad) 55:215-224.

Moron, A. and D.F. Risso. 2001. Phosphorus, sulphur and micronutrients on grassland improvement with white clover (*Trifolium repens* L.) on basaltic soils in Uruguay. pp.181-182. In: Proc. of the XIX Int. Grassl. Cong. 11-21 February 2001. Sao Pedro, Sao Paulo, Brazil.

Paterson, R. 1986. Pasture seed production on Antigua. pp. 317-323. In Proc. of the XXII Annual Meetings of the Caribbean Food Crops Soc. Meeting. St. Lucia. August 25-29, 1986.

Valencia, E. and M.B. Adjei. 2001. Tropical legumes to augment forage yield in the eastern Caribbean. pp. 116-117. In: Proc. of the XIX Int. Grassl. Cong. 11-21 February 2001. Sao Pedro, Sao Paulo, Brazil.

Table 1. Monthly rainfall (mm) totals on St. Croix, US. Virgin Islands, 1999 - 2000.

Month	1999	2000	Average†
January	91	82	61
February	55	74	41
March	9	26	42
April	153	24	58
May	27	46	94
June	39	21	60
July	71	60	76
August	130	69	112
September	242	125	152
October	151	173	129
November	303	98	142
December	149	49	93
Total	1420	847	1060

†20 yr precipitation average for St. Croix, USVI.

Table 2. Mean forage dry matter (DM), pod yield and 100-seed weight of glycine in year 1 as affected by fertilizer treatment (FT).

FT	DM (kg ha^{-1})	Pod yield (kg ha^{-1})	100-seed weight (mg)
Control	3095	225	672.5
TSP	3402	370	668.2
K_2O	3012	395	643.5
Sulfur	3167	387	681.7
Micro-nutrient	3302	375	698.2
F Test	P=0.18	P=0.20	P=0.62
LSD (P=0.05)	†NS	NS	NS

† Not significant.

Table 3. Mean forage dry matter (DM), pod yield and 100-seed weight of glycine in year 2 as affected by fertilizer treatment (FT).

FT	DM (kg ha^{-1})	Pod yield (kg ha^{-1})	100-seed weight (mg)
Control	3550	445	530
TSP	3300	528	646
K_2O	3617	979	673
Sulfur	3945	895	665
F Test	P=0.10	P<0.05	P=0.67
LSD (0.05)	838	470	†NS

† Not significant.