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Performance of Subterranean Clover on Lignite Mine Spoil

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Summary

Establishment and growth of subterranean clover as influenced by fertilization and inoculation with *Rhizobium* were evaluated on lignite mine spoil. In 1987, greatest dry matter yields were produced on inoculated plots where phosphorus (22 lbs/A) and potassium (42 lbs/A) were applied. Addition of nitrogen did not significantly increase yields. Inoculation resulted in the production of approximately 800 lbs/A of extra dry matter as compared to yields from areas receiving nitrogen fertilizer (51 lbs/A) normally applied during spoil revegetation, comprising a 62 percent increase in dry matter production. By the end of the first growing season, ground coverage by the clover ranged from 80 to 95 percent of the plot area. These results indicate that subterranean clover can be quite useful in programs for mine spoil revegetation through provision of ground cover for erosion control and forage production.

Introduction

An estimated one million acres of land will be disturbed by the mining of near-surface lignite deposits in Texas (Clarke and Baen 1980). Although coastal bermudagrass (*Cynodon dactylon* L.) monocultures are commonly used in mine spoil reclamation, the successful utilization of clovers as reclamation species has been reported (Hons et al. 1980). The potential for reducing erosion and for supplying additional nitrogen to companion species makes subterranean clover (*Trifolium subterraneum* L.; subclover) an excellent choice among plants for reclamation programs. The lack of an effective nitrogen-fixing bacterial population (*Rhizobium*) is a major limitation to the establishment and persistence of subclover (Knight et al. 1982). Mott (1984) found indigenous populations of *Rhizobium* in lignite mine spoil areas in Texas, but the rhizobia were ineffective in association with subclover. This study was conducted to evaluate the effects of inoculation and fertilization on the establishment and growth of subterranean clover.

Procedure

A field study was established in October 1986, at the Big Brown Mine near Fairfield, Texas. 'Mt. Barker' subterranean clover was planted by hand broadcasting seed at a rate of 30 lbs/A, then raking the seed into the spoil. The seed was inoculated with a commercial, mixed-strain inoculant (Nitragin Co.) prior to planting. Uninoculated plots were also included. Native rhizobia capable of fixing nitrogen in association with subclover were present in low numbers (0 to 10^2 rhizobia/g soil) in the mine spoil prior to plot establishment. Three fertilization treatments were utilized in the study. Plots were fertilized with 300 lbs/A of 17-17-17 (N, P_2O_5, K_2O) or 0-17-17, and nonfertilized plots were also maintained. Individual plots were 6.6 ft × 6.6 ft and four replications of each treatment were included. Plots were clipped twice to a 3-inch height with a Snapper Hi-Vac mower equipped with a catcher to determine dry matter forage yields. Ground coverage was estimated three times during the growing season using the percentage area estimation method (Brown 1954).

Results and Discussion

The dry matter yields of the subclover for individual harvests and the seasonal totals for 1987 are shown in Table 1. At the first harvest, yields were greatest in the inoculated plots when at least phosphorus and potassium were added. Addition of nitrogen did not significantly increase yields. Lowest yields were found in the inoculated and uninoculated plots where no fertilizer was applied. Yields were not significantly different between any treatment at the second clipping but were greater in both the inoculated and uninoculated plots where phosphorus and potassium were added. Cumulative dry matter yields of subclover were greater in the inoculated plots across all fertilizer treatments. Highest yields were found in the inoculated plots where phosphorus and potassium were added, and the addition of nitrogen did not significantly increase yields. Approximately 800 lbs/A of extra dry matter were gained by inoculating with appropriate rhizobia instead of applying fertilizer nitrogen. Early season forage production was greatly increased through seed inoculation, even though low numbers of effective, indigenous rhizobia were present in the field plots.

Vegetative cover was estimated on three dates in 1987 (Table 2). Three months after planting, the uninoculated plots with no nitrogen fertilization had the poorest ground coverage, while the other plots had between 60 to 72 percent of the ground covered by subclover. By the end of the first growing season, ground coverage of all plots ranged from 80 to 95 percent of the plot area. The ability of subclover to form dense vegetative mats during the growing season demonstrates the usefulness of this legume for reducing erosion on newly levelled mine spoils.

TABLE 1. DRY MATTER PRODUCTION BY SUBTERRANEAN CLOVER GROWN ON LIGNITE MINE SPOIL AS AFFECTED BY INOCULATION AND FERTILIZATION

Treatment	Harvest Date 3/12/87	4/09/87	Total
	--------- Pounds/Acre ---------		
Inoculated — No Fert.	87c*	309a	396cd
Inoculated — 0-17-17	1,375a	815a	2,190ab
Inoculated — 17-17-17	1,554a	945a	2,499a
Uninoculated — No Fert.	0c	198a	198d
Uninoculated — 0-17-17	202c	606a	808cd
Uninoculated — 17-17-17	366b	994a	1,360bc

*Means in each column followed by the same letter are not significantly different at p=.05 by Fisher's LSD.

TABLE 2. GROUND COVERAGE BY SUBTERRANEAN CLOVER GROWN ON LIGNITE MINE SPOIL AS AFFECTED BY INOCULATION AND FERTILIZATION

Treatment		Date of Estimate		
		1/13/87	4/09/87	5/20/87
		---------	% plot area	---------
Inoculated	— No Fert.	60.0a*	62.0cd	82.5a
Inoculated	— 0-17-17	72.5a	92.5ab	94.8a
Inoculated	— 17-17-17	70.0a	95.2a	92.5a
Uninoculated	— No Fert.	32.5b	55.0d	80.0a
Uninoculated	— 0-17-17	35.0b	77.1bc	82.8a
Uninoculated	— 17-17-17	66.2a	90.4ab	95.0a

*Means in each column followed by the same letter are not significantly different at p=.05 by Fisher's LSD.

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