

BLACK LOCUST EFFECTS ON FORAGE YIELD AND NUTRITIVE QUALITY PRODUCED ON RECLAIMED MINED LAND

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ABSTRACT

Black locust (*Robinia pseudoacacia* L.) is a rapidly growing, leguminous tree species often used to stabilize disturbed sites. The objectives of this study were to measure the effect of black locust populations on understory forage production and livestock nutritive quality on reclaimed surface mined land. In two out of three years, forage dry matter yields harvested under a population of 1368 trees ha⁻¹ were not different than the clear cut treatment (all trees removed). Forage dry matter production was significantly reduced at populations of 2736 and 4145 trees ha⁻¹ due to slow and limited regrowth following harvest. Forage nutritive quality was not effected by black locust populations.

KEYWORDS

Black locust, N fixation, dry matter accumulation, nutritive quality, pastureland, mine reclamation

INTRODUCTION

Early U.S. surface mine reclamation revegetation regulations permitted the inclusion of black locust in seeding mixtures where pastureland was the designated post-mine land use. Throughout the eastern U.S. coal mining region, black locust has been recognized as a tree species that provides quick cover for stabilizing disturbed sites. Black locust is a legume, thus has the ability to fix nitrogen (N) at rates of 56 kg ha⁻¹ yr⁻¹. This combined with the leaf litter deposition and light shade black locust provides, creates an environment suitable for forage production on reclaimed surface mine lands (SCS, 1978).

Black locust is regarded as a temporary woody cover due to severe infestations of locust borer (*Megacyllene robiniae*) that often develop in pure stands, resulting in significant stand declines over a relatively short period of time (approx. 8 years). Unfortunately, little information is available on the influence of black locust densities on understory forage production, quality and species composition. This information would be valuable to coal companies responsible for pastureland reclamation, regulatory agencies responsible for determining compliance with state and federal reclamation laws and land owners interested in livestock forage production. Therefore, the objectives of this study were to: i) measure forage dry matter accumulation under various black locust densities on reclaimed surface mine land and ii) measure influence of black locust densities on forage nutritive quality.

METHODS

A reclaimed surface mined site in eastern Kentucky, with a six year old stand of black locust, was selected to study the effects of black locust population on understory forage production and nutritive quality. The study site was located at an elevation of 2,200 feet on a 22% slope with an east facing aspect. Mine spoil pH was 6.4 and composed of sand stone and gray shale. Mehlich III extractable P and K levels were 35 and 248 kg ha⁻¹, respectively. Initial forage understory was predominately composed of timothy (*Phleum pratense*), orchardgrass (*Dactylis glomerata*), tall fescue, (*Festuca arundinacea*) and serica lespedeza (*Lespedeza cuneata*). A black locust density of 4,145 trees ha⁻¹ was determined for the site and subsequently thinned to obtain a 100, 66, 33 and 0% population of the original stand in the fall of 1992. Individual plots size was 8.2 x 15.2 m with each treatment replicated 3 times in a RCB design.

Forage samples for dry matter determination and nutritive quality were hand harvested twice per growing season from a 1.8 x 1.8 m area in the center of each plot beginning in the spring of 1993. Forage was analyzed for total nitrogen, neutral detergent fiber (NDF), acid detergent fiber (ADF) cellulose, acid detergent lignin (ADL) and in vitro dry matter disappearance (IVDMD) (Robertson and Van Soest, 1978; Van Soest et al., 1978; Taylor et al., 1992).

RESULTS AND DISCUSSION

Highest understory forage dry matter yields were measured each year in plots where all black locust trees were removed. (Table 1). However, in 1993 and 1995, dry matter yields in the 33% black locust plots were not different from the clear cut plots (0% trees) suggesting that a population of 1368 black locust trees ha⁻¹ may not reduce forage production compared to complete removal of all trees. Lowest dry matter yields were consistently measured at the high black locust population of 4145 trees ha⁻¹ which did not differ statistically from a population of 2736 trees ha⁻¹. Forage regrowth after harvest was slow and often not measurable at the 100% tree population. This reduction in forage production is likely due to increased shade and high soil water demand by black locust trees.

Lush growth of tall fescue and orchard grass around the base of black locust trees is commonly observed on mine spoil. This increased forage growth, compared to adjacent areas suggest that N fixation by black locust is beneficial to understory forage. These data suggest that N nutrition is not greater surrounding black locust and not affected by black locust population. The appearance of improved forage growth under black locust may be related to less moisture stress where thin black locust populations provide light shade. The deep root system of black locust may also reduce soil compaction and improve water infiltration.

Forage quality, was not affected by black locust population as indicated by NDF levels reported in Table 2.

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Table 1

Effects of black locust population on understory forage dry matter accumulation.

Black Locust Population (# ha ⁻¹)		Dry Matter Accumulation (Mg ha ⁻¹) [†]		
		1993	1994	1995
4145	(100) [‡]	1.1 b [§]	0.2 c	0.5 b
2736	(66)	1.5 b	0.4 c	0.6 b
1368	(33)	1.9 ab	0.9 b	0.8 ab
0	(0)	2.3 a	1.4 a	1.0 a

[†] Plots were harvest twice per season in 1993-1994 and only once in 1995 due to limited regrowth.[‡] Values in parenthesis indicate the percentage of original black locust stand.[§] Values within a column followed by the same letter are not significant at the 95% level of probability.**Table 2**Effects of black locust population on understory forage nutritive quality.[†]

Black Locust Population trees ha ⁻¹		Forage Nutritive Quality Characteristics		
		Total N	NDF%.....	ADF
4145	(100) [‡]	1.49 a [§]	69.1 a	45.7 a
2736	(66)	1.46 a	68.3 a	49.3 a
1368	(33)	1.33 a	69.5 a	42.0 a
0	(0)	1.22 a	69.3 a	43.4 a

[†] Forage quality measured at final harvest in 1995.[‡] Values in parenthesis indicates percentage of original black locust stand.[§] Values within the same column followed by the same letter are not significantly different at the 95% level of confidence.