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Early Performance of Mycorrhizal and Nonmycorrhizal Big Trefoil in a Forest Soil

M.M. Schoeneberger, R.J. Volk, and C.B. Davey
North Carolina State University
Raleigh, North Carolina 27695-8002, U.S.A.

Big trefoil (Lotus pedunculatus Cav. cv Marshfield), along with subterranean clover (Trifolium subterraneum L. cv Mt. Barker), are currently being investigated for their usefulness in forest operations. The economics of using these and other leguminous plants in forests necessitates good initial establishment as well as good initial plant performance (i.e. biomass and N-fixation) that will determine subsequent reestablishment. One potential to enhance plant performance in the low fertility, high acidity soils generally encountered in forest systems lies in the use of vesicular-arbuscular mycorrhizae (VAM). A greenhouse study was conducted to determine the effect of VAM on early growth and N-fixation of big trefoil and subterranean clover in a forest soil. This report will deal only with data on big trefoil.

Seed of big trefoil were sown in pots containing steam-sterilized forest soil (Norfolk sandy loam, pH 4.9). The soil had previously been labelled with 15-N urea (99at.%ex) at either 10 kg N/ha or 100 kg N/ha. Treatments were as follows:

1. Control
2. +RHIZOBIUM (Bradyrhizobium sp. (big trefoil) L001-NCSU)
3. +MYCORRHIZA (Gigaspora margarita)
4. +RHIZ-MYC

Perennial rye grass served as the reference plant for 15-N determinations. Plants were grown for 2½ months in a greenhouse, watered when needed with deionized water, and given a 16 hour daylength with supplemental lighting.

At 2½ months, plants inoculated with VAM (+MYC) had significantly greater biomass than the control or +RHIZ-only plants (Table 1). Nodule number was not affected by VAM inoculation. Increasing N rate increased biomass production within inoculation treatment but had no effect on nodule number (Table 2). Plants with +RHIZ-MYC had greater shoot and root dry weight, however, these differences were statistically significant for the 100 kg N rate only. Approximately 54% and 40% of the shoot's N of plants grown at the 10 and 100 N rate respectively were derived from fixation regardless of inoculation treatment (Table 3). Total nitrogen derived from fixation in the shoots was increased by +MYC inoculation and decreased by increasing N rate. Theses differences were small and not statistically different. +MYC inoculation had no effect on shoot P status. Although big trefoil growth was found to be affected by VAM, it was not affected to the extent or in the same manner as subterranean clover.

TABLE 1. Dry weights and nodule number for big trefoil grown for 2½ months in a forest soil.

Treatment	Total Dry Wt.	Root Dry Wt.	Nodule Number
	mg/plant		# /plant
Control	140a [1/]	33a	0a
+RHIZ	188a	46a	13b
+MYC	227b	52b	0a
+RHIZ-MYC	233b	52b	14b

[1/] Mean (n=6) separation in columns by Duncan's multiple range test ($P \leq 0.05$)

TABLE 2. Dry weights and nodule number for N-fixing big trefoil separated by N rate.

Treatment	Shoot Dry Wt.		Root Dry Wt.		Nodule Number	
	mg/plant				# /plant	
	10N	100N	10N	100N	10N	100N
+RHIZ	130	156	42	49	13	13
+RHIZ-MYC	156	203*	45	61*	15	14

*Significantly different from +RHIZ at $\alpha=0.05$.

TABLE 3. Nitrogen and phosphorus data for N-fixing big trefoil shoot material separated by N rate.

Treatment	Total N		Total Fixed N		Total P		Percent Fixed N	
	mg/plant						%	
	10N	100N	10N	100N	10N	100N	10N	100N
+RHIZ	3.8	4.3	2.1	1.7	0.2	0.2	54	39
+RHIZ-MYC	4.5	5.2	2.5	2.1	0.2	0.2	54	41