Influence of fertilizer on survival of shrub lespedeza planted on acid spoils

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Nitrogen fertilizer, in conjunction with rock phosphate, was beneficial to survival.

Shrub lespedezas *(Lespedeza spp.)* have some desirable qualities for planting on strip-mine spoils. They provide food and cover for wildlife, especially small game birds; and they may be superior to many tree species as a nurse crop for interplanted seedlings. Like most legumes, the shrub lespedezas are nitrogen fixers. They grow to a maximum height of 10 to 15 feet.

Several greenhouse trials with spoils deficient in nitrogen and phosphorus indicated that seeded legumes made their best initial growth when moderate amounts of nitrogen and high rates of phosphorus were applied. Although legumes fix nitrogen, they seem to utilize applied nitrogen for early growth until nodulation and fixation begins.

This report is about the survival rates after three growing seasons of planted shrub lespedeza in relation to various types of phosphorus applied with and without nitorgen. The growth response of the seedlings to the fertilizer treatments has not yet been determined.

The study area is located near Lily, Kentucky. It had been strip-mined about 1964 and then regraded to a gently rolling topography. When the seedlings were planted in 1967, the spoils were dark gray to black shales with a pH range of 3.2 to 1.8. No previous attempt had been made to vegetate the spoils, and there was little or no volunteer vegetation on the site. Spoil analysis revealed a deficiency in both nitrogen and phosphorus. Potash was found to be sufficient.

Methods

We planted 1,960 lespedeza seedlings, 1-0 stock, at a spacing of -1 feet X 4 feet in April 1967. There were 8 blocks, each containing 20 rows of 10 plants, and 3 blocks, each containing 20 rows of 6 plants. We used nine fertilizer treatments, and one control group. A treatment was assigned at random to each row.

In treatments 2 through 4, all fertilizer applied to each tree was mixed with spoil in the planting hole (table l) . In the other treatments two-thirds of the phosphate fertilizer applied was mixed with the spoil in the planting hole; the remaining phosphate fertilizer and all of the nitrogen fertilizer were placed in two slits about 6-to-8 inches deep located 6-to-8 inches from the planted trees (table 1). This method proved effective when used on black locust *(Rohinia pseudoacacia L.)* planted in extremely acid spoils.

Table 1.—The treatments used on planted lespedeza

Treatment No.	Treatment	Fertilizer rate: Mixed in planting hole	Fertilizer rate: Applied as side dressing
		grams	*grams*
1.	Control	0	0
2.	Rock phosphate (1x)	130	0
3.	Dicalcium phosphate (1x)	80	0
4.	Triple-superphosphate (1x)	80	0
5.	Rock phosphate (1.5x)	130	65
	Ammonium nitrate	0	33
6.	Dicalcium phosphate (1.5x)	80	40
	Ammonium nitrate	0	33
7.	Triple-superphosphate (1.5x)	80	40
	Ammonium nitrate	0	33
8.	Rock phosphate (6x)	520	260
	Ammonium nitrate	0	33
9.	Dicalcium phosphate (6x)	320	160
	Ammonium nitrate	0	33
10.	Triple-superphosphate (6x)	320	160
	Ammonium nitrate	0	33

(nx) = n times initial rate.

Statistically. we had 22 rows receiving each treatment. including the control group. Assuming that survival is independent of block we compared the data from each treatment with the data from the other treatments. using an unpaired 't' test. Because we had so few plants per plot. we converted the survival percentages from each row to their arcsin equivalents.

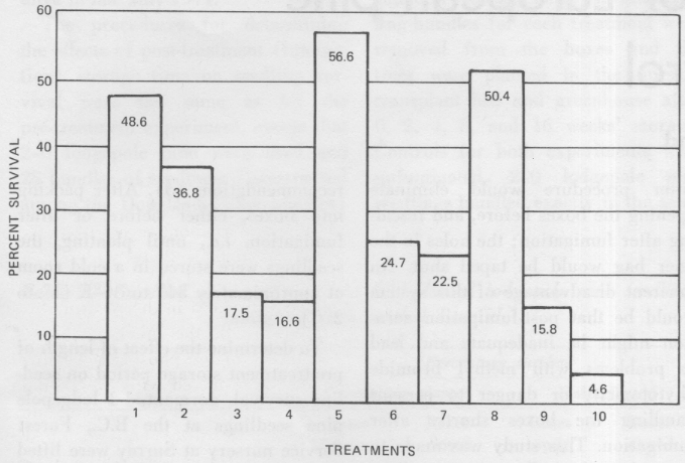

Figure 1.—Percentage survival of *Lespedeza* spp. from 9 fertilizer treatments and 1 control group on extremely acid spoils.

1. Control, No Treatment
2. (1x) Rock Phosphate
3. (1x) Dicalcium Phosphate
4. (1x) Triple-Superphosphate
5. Ammonium Nitrate plus (1.5x) Rock Phosphate
6. Ammonium Nitrate plus (1.5x) Dicalcium Phosphate
7. Ammonium Nitrate plus (1.5x) Triple-Superphosphate
8. Ammonium Nitrate plus (6x) Rock Phosphate
9. Ammonium Nitrate plus (6x) Dicalcium Phosphate
10. Ammonium Nitrate plus (6x) Triple-Superphosphate

Table 2.—Table of significance. Showing significance[1] of survival differences from each fertilizer treatment when compared with all other fertilizer treatments on shrub lespedeza

Treatment	Treatment									
	1	2	3	4	5	6	7	8	9	10
1.....	—	NS	**	**	NS	*	**	NS	**	**
2.....	—	—	**	*	*	NS	NS	NS	*	**
3.....	—	—	—	NS	**	NS	NS	**	NS	**
4.....	—	—	—	—	**	NS	NS	**	NS	*
5.....	—	—	—	—	—	**	**	NS	**	**
6.....	—	—	—	—	—	—	NS	*	NS	**
7.....	—	—	—	—	—	—	—	**	NS	**
8.....	—	—	—	—	—	—	—	—	**	**
9.....	—	—	—	—	—	—	—	—	—	NS
10.....	—	—	—	—	—	—	—	—	—	—

NS = Difference not significant.
* = Significant difference (5 percent level).
** = Highly significant difference (1 percent level).
[1] An unpaired 't' test was used by comparing data from each treatment with all other treatments.

Results

Seedlings in the control group, in treatment 5 (ammonium nitrate + 1.5x rock phosphate). and in treatment 8 (ammonium nitrate + 6x rock phosphate) had the highest survival rate (figure 1). Although seedlines in treatments 5 and 8 had better survival rates than those in the control group. the differences were not statistically significant (table 2). The seedlings in treatment 10 (ammonium nitrate + 6x triple-superphosphate) had the lowest survival rate. The remaining treatment groups fall somewhere in between.

At the rates used in this study. survival was significantly reduced by any treatment using dicalcium phosphate or triple-superphosphate in the planting hole. Triple-superphosphate seemed to be more detrimental to survival than dicalcium phosphate, but not significantly so. The addition of nitrogen fertilizer to dicalcium phosphate and triple-superphosphate slid not increase survival as it did when it was added to rock phosphate.

Conclusions

We conclude from the results of this study that dicalcium phosphate or triple-superphosphate, by themselves or in combination with nitrogen fertilizer, were detrimental to the survival of shrub lespedeza on extremely acid spoils, at least in the amounts used and manner applied. Even the use of rock phosphate alone seemed to be detrimental, but the difference was not statistically significant. However, it seems that nitrogen fertilizer, in conjunction with rock phosphate was beneficial to survival. However, we are not sure at this time

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whether nitrogen alone would have produced this reaction. This was not significant when treatments 5 and 8 were compared with the control, but plant survival of treatment 5 was significantly greater than treatment 2. Also, survival from treatments 5 and 8 may have been enhanced by lack of toxic levels of phophorus.

We do not know exactly why dicalcium phosphate and triple-super phosphate were detrimental to plant survival on these spoils. We can only speculate that triple-super phosphate, when added to an already extremely acid spoil, was immediately soluble in the soil water and simply increased the acidity and salt concentration of the soil solution to a level that was highly toxic to the plants.

We cannot even speculate as to why dicalcium phosphate inhibited survival, except to say that there may have been a complex and detrimental chemical reaction.

Rock phosphate, on the other hand, is very slowly soluble and would have less effect on the acidity and salt concentration of the soil solution. In fact, rock phosphate added to acid spoils wi11 reduce the toxic effects of acidity in some spoils, much as the addition of lime does. Possibly, if the fertilizers had been broadcast or drilled instead of mixed and side dressed,. they would have given different results.