Effect of Acidity on Germination of some Grasses and Alfalfa

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Highlight: *Germination of blue panicgrass, Lehmann lovegrass, buffelgrass, common bermudagrass, and alfalfa was studied in petri dishes containing sulfuric acid solutions ranging in pH from 7.0 to 1.0. Above pH 4.0 there was no significant decrease in percent germination. Lehmann lovegrass and common bermudagrass did not germinate at or below pH 3.0. Alfalfa and buffelgrass were the most acid tolerant species tested.*

Revegetation of land areas adversely affected by acid effluent from strip mining of coal and from the natural oxidation of pyrite (Blevins et al., 1970) is an important and current environmental concern. For aesthetic reasons and to prevent soil erosion, attention in the Southwest has been directed toward establishing a plant cover on exposed mine tailings and spoil banks (Ludeke, 1973). In addition, acidifying materials such as sulfuric acid, which is predicted to become a surplus commodity in the Southwest, can be used to enhance the physical and nutritional status of alkaline and calcareous soils (Ryan et al., 1973). Where such ammendments are used, varying degrees of soil acidity are encountered. Consequently, it is important to have a measure of tolerance to acidity for plant species used for revegetation.

Although acid scarification of seed as a pretreatment has been shown to be effective in increasing germination in some species (Blankenship and Smith, 1967), the effect of prolonged acidity on grass seed germination has received little attention. This paper examines the effect on germination of acidity produced by sulfuric acid.

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Materials and Methods

Seeds of the following species were used in the study: blue panicgrass (*Panicum antidotale*), buffelgrass (*Pennisetum ciliare*) common bermudagrass (*Cynodon dactylon*), Lehmann lovegrass (*Eragrostis lehmanniana*), and alfalfa (*Medicago sativa*). After treatment with 0.1% $HgCl_2$ to prevent fungal growth, 50 seed lots were placed in sterile petri dishes containing 10 ml dilute sulfuric acid solution. Sulfuric acid was used as an acidulant since this is the most common acid

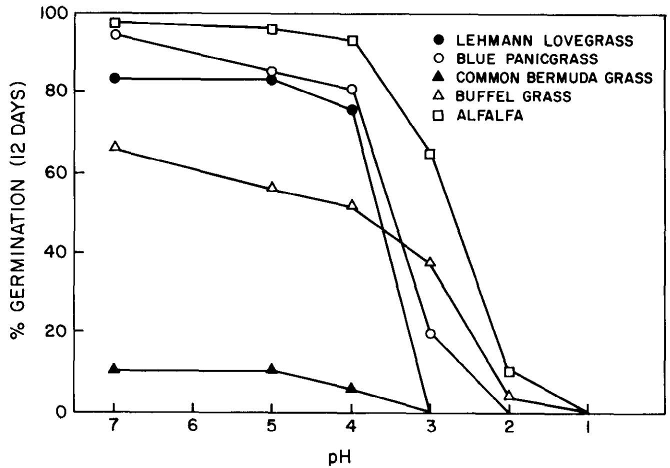

Fig. 1. *Relationship between acidity and rate of germination of grass species.*

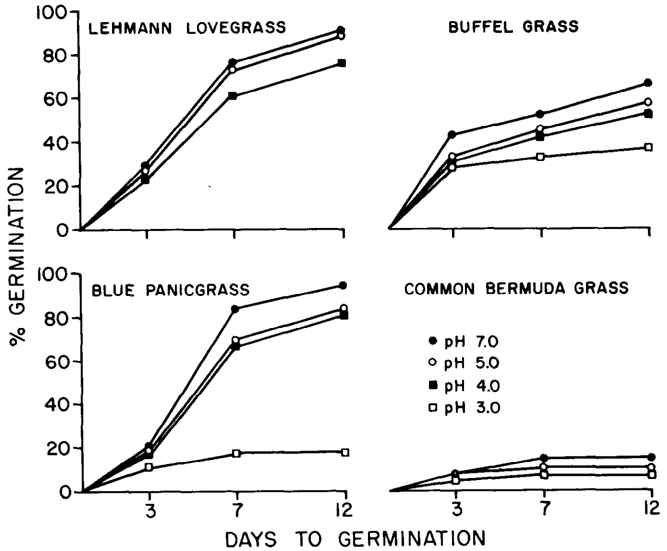

Fig. 2. *Relationship between acidity and mean percent germination.*

occurring in the soil conditions of interest. The pH values of the solutions were 7.0, 5.0, 4.0, 3.0, 2.0, and 1.0. The pH was maintained constant by periodically changing the solutions. Seeds which had germinated were counted at 3, 7, and 12 days after initiation of the experiment. Each treatment was replicated five times. Temperature was maintained at 80°F with 10 hours of fluorescent light provided daily.

Results and Discussion

The percent germination with time under different conditions of acidity is shown for four grass species in Figure 1. Alfalfa seeds germinated completely within 3 days and showed no change in germination percent with time, and so the data are excluded from the figure. Blue panicgrass and Lehmann lovegrass germinated more rapidly than buffelgrass and common bermudagrass. Higher levels of acid reduced the germination rate of all grasses, particularly blue panicgrass.

The percent germination obtained at 12 days is plotted against pH of the solution in Figure 2. The pattern of response to acidity was similar for all species. However, the extent of reduction in germination with increasing acidity varied with the species. At pH 3.0 blue panicgrass was reduced by approximately 75%, alfalfa by 30%, and buffelgrass by 25%. Both Lehmann lovegrass and common bermudagrass failed to germinate at pH 3.0. Only a few seeds of the alfalfa and buffelgrass emerged at pH 2.0 and none of the other species. No germination of any species occurred at pH 1.0. The relatively poor germination of the common bermudagrass seed was probably due to quality of the seed lot.

The conclusion of this study is that increasing the H^+ ion concentration or decreasing pH has an adverse effect on germination. However, some discrepancies with other work are apparent when the magnitude of this effect is considered. Salter and McIlvaine (1920) observed no reduction in germination of alfalfa at pH 3.0, compared with a 30% reduction in the present study. However, these authors concluded that pH values above 3.0 were most favorable for germination. In contrast to the present findings, a recent study of Stubbendieck (1974) showed that germination of blue panicgrass in the pH range 4.0 to 6.0 was significantly greater than at neutrality. No apparent explanation is available to reconcile these conflicting results. Consistent with the present findings, however, Stubbendieck (1974) found that blue panicgrass did not germinate in conditions of high acidity (pH 2.5).

The concentrations of SO_4 used here were not sufficient to cause any inhibition of germination (Ryan et al., 1974). In field conditions, however, the effect of H^+ ions *per se* would be compounded by toxic level of other ions whose solubility is controlled largely by soil pH (Black, 1968). Consequently, laboratory studies using nutrient culture are at best only a tentative guide to field application. As such a guide, buffelgrass was significantly better than the other species at pH 3.0; it thus appears most suitable for planting on relatively acid soils. Alfalfa appears to be a suitable forage crop for such conditions. When H_2SO_4 is applied to soils, seeding should be delayed until the acid has completely reacted with soil bases. Recovery of the pH of calcareous soils is relatively rapid, depending on the amount of base present in the soil.

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