

Effect of pH on Germination of Four Common Grass Species of Ujjain (India)

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Highlight: The effect of acids and bases on the seed germination of four important grasses were evaluated at Ujjain (India). The species were *Iseilema antheaphoroides*, *Sehima nervosum*, *Apluda mutica* and *Dactyloctenium aegyptium*. The seeds were treated in petri dishes by pH solutions ranging from 2.0 to 11.0 and percent of germination was recorded. No germination was observed at pH 2.0 in any species. In contrast to that of the *Apluda*, germination of *Iseilema* and *Sehima* was better in acidic medium. *Dactyloctenium* had high germination at all pH levels. The graph between pH and percent germination reveals a curvilinear relationship. Second degree quadratic equation $Y = a + bX + cX^2$ was fitted for each species to get the best estimate of the percent of germination for any particular pH value. Statistical analysis shows significant differences among the different pH levels and among species.

Difficulties in obtaining good germination of grass seeds under natural condition have received considerable attention (Bruns and Rasmussen, 1958; Toole et al., 1956). The germination of seeds of grass plants has been of particular interest and has been subjected to detailed studies by Dahlberg (1916), Arny (1927), Williams (1968), and Stubbendieck (1974). It has been found that in grass seeds the germination-regulating mechanism is complicated and varies from one species to another in the same genus. One factor that has received little attention is the effect of pH. Soil pH was found to determine species distribution by affecting germination (Justice and Reece, 1954). The effect of acidity and alkalinity (H^+ concentration) on seed germination and plant growth in nature is a rather profound one. Although a mass of data exists on the relation of soil acidity and alkalinity to plant growth, only a few studies made with water culture have attempted to examine such an effect including the germination stage.

The effects of acid and alkali upon the germination of seeds have been studied by Michaels (1910), Promsy (1911), and Plate (1913). A general conclusion from these investigations may be that a strictly acid reaction exerts an injurious effect.

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Furthermore, they point out that the relationship of germination to acidity varies considerably with the seeds of different plants and with the kind of acids used, organic acids being more favourable than inorganic, when used in equivalent amount.

Materials and Methods

The present studies were made on four dominant grasses of Ujjain (23° 11'N, 75° 43'E) commonly occurring throughout the Madhya Pradesh State on various types of soil. These were *Sehima nervosum* (Rottl.) Stapf., *Iseilema antheaphoroides* Hack., *Apluda mutica* Hack. and *Dactyloctenium aegyptium* (L.) Richter. Seeds were collected in October and November, the time for ripening of seeds of the four species studied. All seeds were kept 4 to 5 months in air-tight glass bottles because all have a 4- to 5-month dormant period (Singh, 1969; Mall, 1972; and Gupta, 1973).

Petri dishes with Whatman No. 1 filter papers in the bottom were used as germination containers. The range of hydrogen ion concentration was established by adding hydrochloric acid or potassium hydroxide to distilled water. The pH levels of the solutions used were 2.0 to 11.0. Ten milliliters of a solution was added to each petri dish and 100 seeds for each species were placed in it. Germinated seeds (when coleoptile was > 2 mm for *Dactyloctenium* and coleorhiza was > 2 mm for the remaining three species) were removed after counting. For each pH treatment sufficient replications were taken to have reliable experimental finding. All the data so obtained were treated for various statistical analyses.

Results and Conclusions

Figure 1 shows that each grass species responded differently to varying pH levels during germination. No germination was recorded at pH 2.0 in any species. At pH 2.5, *Iseilema* alone is capable of germination. Seed of this grass shows better germination towards the acidic range than on the alkaline side, with maximum percentage germination at pH 5.0. Similar results have been shown by *Sehima*. These data support the view of Salter and McIlvaine (1920), who concluded that slight acid reaction is favourable for seed germination.

Contrary to the germination results of foregoing two species, *Apluda* had best germination at alkaline pH values from 8.0 to 9.5. It seems that acidic medium does not favour the synthesis or action of an enzyme necessary for

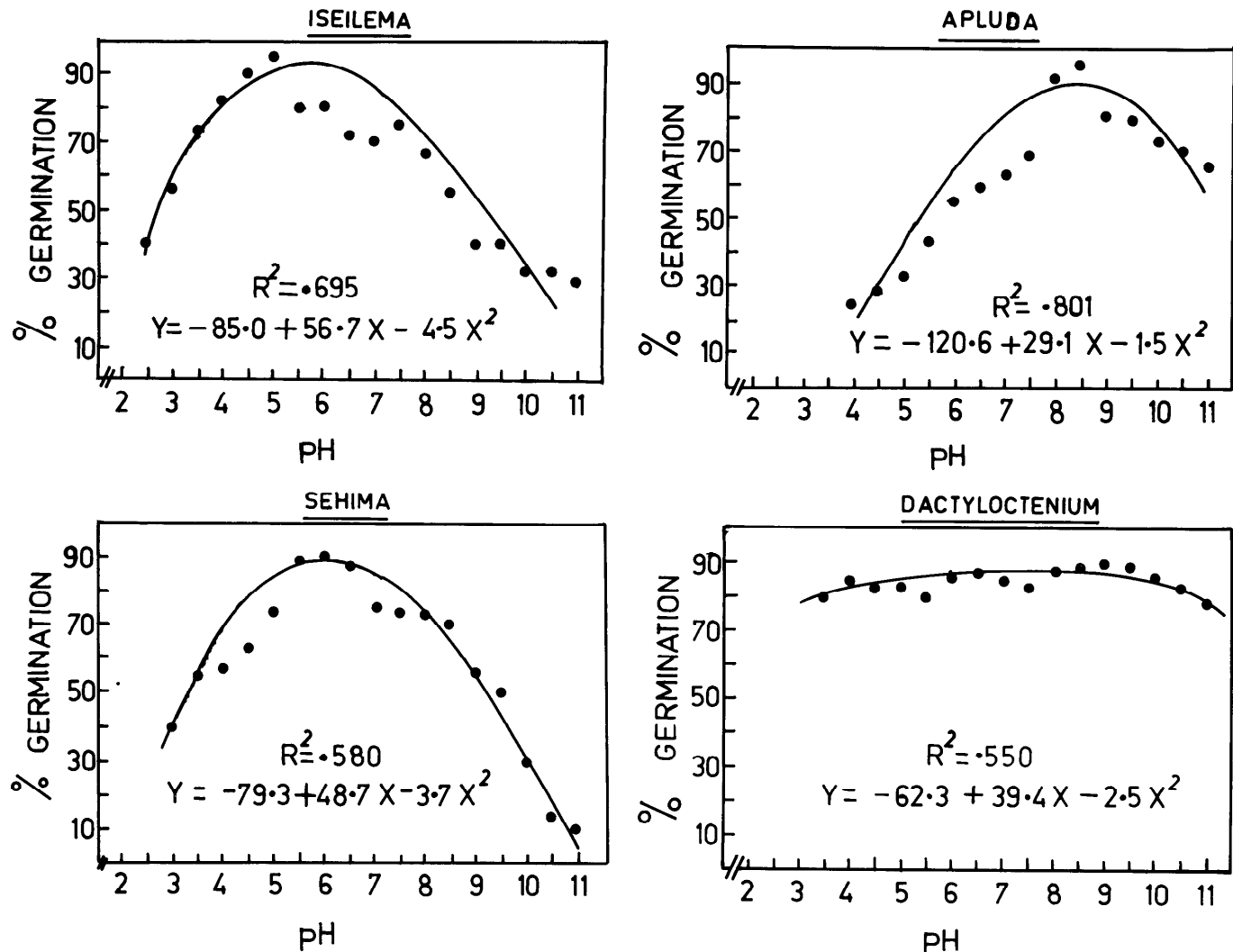


Fig. 1. Graph showing relationship between pH and % germination for the four species.

germination. Thus the effects of acids or bases on germination may be a result of their favourable or unfavourable influence on the enzymic processes concerned. For *Dactyloctenium*, germination was comparatively higher at all levels (Fig. 1). An analysis of variance of the data reveals that statistical significant differences at 5% level occur between the species for percentage germination ($F = 3.993$, df 3 and 54) and for different pH levels ($F = 4.879$, df 18 and 54).

The relationship between pH versus percentage germination reveals a curvilinear nature (convex hyperbola) in the graph (Fig. 1). To obtain a good estimate of the dependent variable (% germination) for any particular value of the independent variable (pH), a quadratic second degree regression of orthogonal polynomial type was fitted to the data for each species:

$$Y = a + bX + cX^2$$

where Y and X represent the percentage germination and pH, respectively. This equation along with the correlation coefficient (R^2) for each species were found to be significant at 5% level.

No germination was noted at pH 2.0.

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