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EFFECT OF GIBBERELLIC ACID AND COLD TREATMENTS ON THE GERMINATION OF BITTERBRUSH SEED

by

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A number of investigations have shown that treatment with gibberellic acid can replace the cold period required to break dormancy in certain seeds. In several instances, acid treatment has also caused significant increases in the root and top growth of seedlings. This combination of abilities suggests that the use of gibberellic acid in reseeding bitterbrush merits serious consideration.

Attempts to revegetate bitterbrush on depleted winter game ranges in central Washington generally have been unsuccessful. With proper seeding-depth control and protection from rodents, germination and emergence of seed is normally satisfactory. As the dry summer growing season progresses, however, seedling mortality is often extremely high--presumably the result of inability to compete for limited soil moisture. If gibberellic acid stimulates bitterbrush growth and increases the depth of root penetration, its use could assist seedlings through these periods of critical soil-moisture stress. As described in the following paragraphs, the combined effects of gibberellic acid and cold treatments on the germination of bitterbrush seed were tested as a preliminary approach to this whole problem.

PROCEDURE

The combined effects of gibberellic acid and cold were studied by varying both the strength of acid and the length of cold. Acid treatments consisted of 25, 50, 100, 200, 500, and 1,000 parts per million

(p. p. m.) of acid in distilled water. Cold treatments were 7, 15, and 30 days of stratification in flats of moist sand at temperatures ranging from 34° to 38° F. No fungicide application was included. Control treatments consisted of zero days of cold and zero p. p. m. of acid in distilled water. For each cold treatment, triplicate 100-seed samples were soaked in each of the acid solutions for 6 hours. After soaking, the seeds were surface dried and placed between moist filter papers in petri dishes to germinate at room temperature for a 30-day period.

All seeds used in the study were graded for size by screening with a 3-mm. soil sieve. Seeds passing through the sieve were discarded.

RESULTS AND DISCUSSION

Germination percentages were analyzed by using actual germination percent as the variable and also by using the angle whose sine is the square root of the germination percent as the variable. Since tests of significance were the same with both procedures, the untransformed data were used for convenience.

An analysis of variance revealed highly significant treatment effects for cold (all acid treatments combined), for acid (all cold treatments combined), and also for interaction between the two kinds of treatment. Comparisons in regression for cold and acid indicated that significant simple curved relations between treatment level and treatment response also exist. Support for a more complicated curve for cold treatment was evidenced by significant deviations from the curvilinear component, but the curve was not determined. The regression curves for the cold and acid treatment averages are presented in figures 1 and 2.

The use of cold stratification to break bitterbrush seed dormancy is well known, and its effectiveness is further demonstrated in figure 1. Unfortunately, however, the curve does not peak and the optimum period of cold stratification cannot be determined. It is also of interest to note (fig. 3) that despite its highly significant effect on germination, gibberellic acid shortened but was not able to entirely replace the cold treatment needed to overcome seed dormancy. With regard to the overall germinative effect of acid, however, maximum average treatment response occurred at approximately 998 p. p. m. (fig. 2).

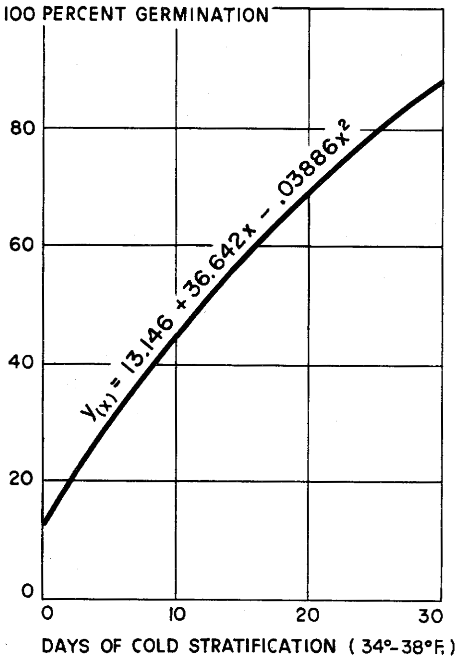

Figure 1.--Effect of cold-stratification treatments on germination of bitterbrush seed (all acid treatments combined).

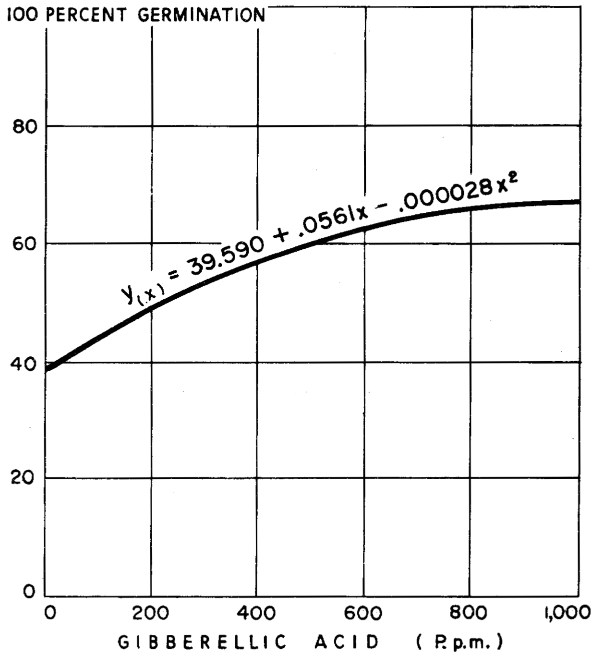

Figure 2.--Effect of gibberellic acid treatments on germination of bitterbrush seed (all cold treatments combined).

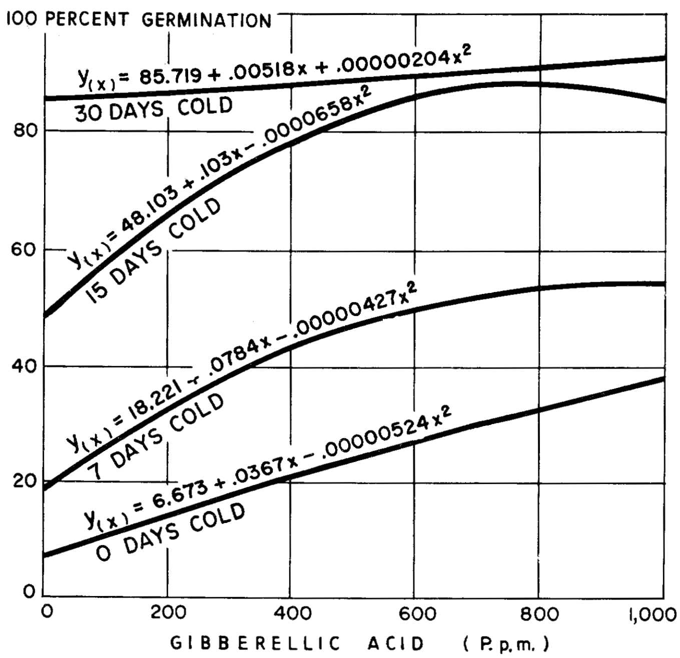

Figure 3.-- Effect of cold-stratification and gibberellic acid treatments on germination of bitterbrush seed.

The significant interaction effect of cold and acid can be seen in the family of acid curves presented in figure 3. Examination of these curves indicates a reduced response to increasing levels of acid as the period of cold stratification lengthens. Thus, in the absence of cold there was an increase in germination of about 33 percent from the least to the most severe acid treatments. For 30 days of cold, the corresponding increase in germination was only 6 percent. Maximum response to acid for the 7- and 15-day cold treatments occurred at approximately 925 p.p.m. and 800 p.p.m., respectively; information on maximum response to acid for zero and 30 days of cold is not available since peak germination rates were not reached. Finally, it would appear from figure 3 that gibberellic acid did not have a real effect on seeds receiving 30 days of cold, but that seeds receiving the other cold treatments were all significantly affected.

In general, the time required for germination was inversely proportional to acid level except for the 30-day cold treatment. Many seedlings receiving no cold treatment and 7-day cold treatment germinated slowly and were adversely affected by the acid. Their cotyledons were thickened and had a chlorotic, waxy appearance and curled, uneven margins. In addition, their radicles were enlarged and truncate in contrast to the conical symmetry found in normally developed seedlings. Survival of these deformed seedlings would appear questionable. It is still of interest, however, to observe growth responses of seeds subjected to 15- and 30-day cold stratification and selected gibberellic acid treatments. These observations are planned for future studies.