GROWTH OF MONTEREY PINE SEEDLINGS IN OUT WASH SAND IMPROVED BY SYENITIC GRANITE WITH EXCESSIVE WATERING [1]

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In this study, the addition of syenite granite to outwash sand caused significant growth improvement of Monterey pine seedlings only in excessively watered soil, although some improvement was noted in moderately watered soil.

The ability of forest trees to utilize potassium present in unweathered silicate rocks and minerals has been repeatedly demonstrated. The conversion of this element into available form is largely accomplished by mycorrhizal fungi and chelating compounds produced by decomposition of root sloughings and fungal mycelia (2, 4, 1, 3).

These previous Wisconsin investigations led to the present study which appraises the effect of soil moisture and corresponding soil aeration on the release of available potassium from syenitic granite.

Procedure

The culture vessels were prepared from 5-inch

alvanized iron pipes, cut to lengths of 9, 18, and 27 inches. These cylinders were coated with plastic to prevent corrosion, filled with the soil and placed in an open pan containing distilled water kept at a constant 5-inch level (fig. 1). Capillary action imparted moisture contents of 28, 12 and 3 percent by volume, respectively, to the 6-inch surface layers of soils.

Half of the 12 cylinders were filled with A,-horizon of siliceous outwash sand of Sparta-Gotham series; the other half with similar sand mixed with 7 percent by volume of 40-mesh syenite containing 4.3 percent K20.

The cultures were planted to surface-sterilized seed of Monterey pine, Pinus radiata, 25 seeds per vessel. Four weeks after germination the growing stock was reduced to 15 plants. The seedlings were harvested in April 1966, after a full year of growth.

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The results of the stock analyses are given in table 1. Figure 2 shows plants produced in control and syenite-enriched soils with different supplies of water.

Results

The excessive moisture content of 28 percent, obtained at 4-inch depth to ground water, exerted a very strong growth-depressing effect, undoubtedly because of deficient aeration. Nevertheless, the ad-

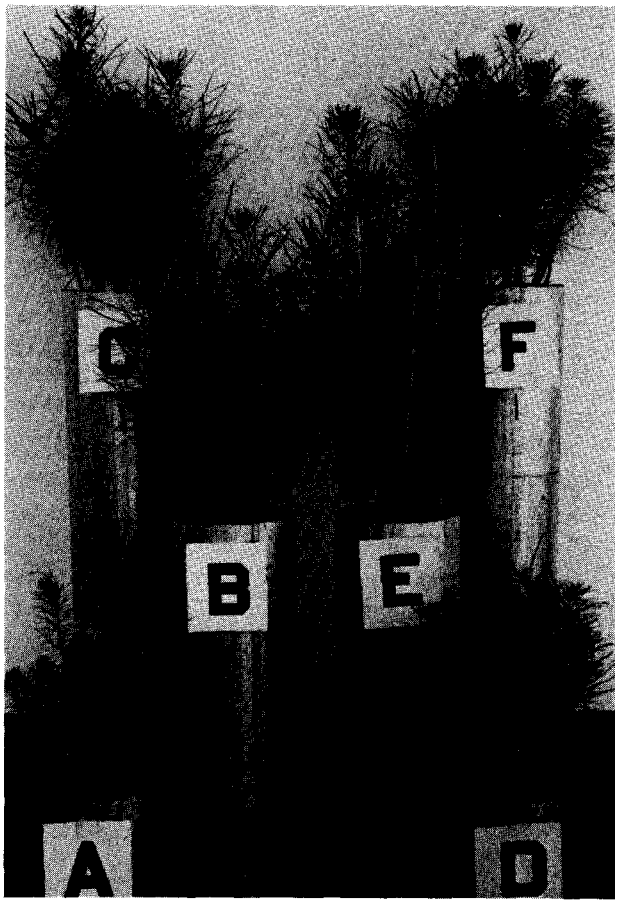

Figure 1.—Subirrigated culture containers of galvanized iron cut to lengths of 9, 18, and 27 inches to obtain soil moisture contents in the surface 6-inch layers of 28, 12, and 3 percent by volume, respectively. Containers *D*, *E*, and *F* at right are syenite-enriched. Note heavier top growth of *D* and *E*.

TABLE 1.—*The effect of syenitic granite on the growth of 1-year-old Monterey pine seedlings raised at different contents of soil moisture*
(RESULTS FOR AVERAGE PLANTS)

Growth Medium	Content of soil moisture pct.	Height of seedling cm.	Length of roots cm.	Stem diameter mm.	Wt. of crowns	Wt. of roots	Top-root ratio	Root titration value ml. NaOH
					Grams	*Grams*		
Control	28	14.7	15.3	1.7	0.52	0.28	1.8	0.19
Syenite-enriched	Do.	16.4	15.0	2.3	1.00	0.47	2.1	0.30
Control	12	26.3	25.7	2.5	1.50	0.63	2.2	0.64
Syenite-enriched	Do.	31.1	28.6	2.6	2.51	0.88	2.8	0.60
Control	3	26.5	42.5	2.6	1.33	0.84	1.6	0.62
Syenite-enriched	Do.	25.5	46.3	2.7	1.37	0.93	1.5	0.50

TABLE 2.—*Effect of syenitic granite on the concentration of elemental potassium in foliage of 1-year-old Monterey pine seedlings raised in subirrigated cultures with different content of moisture.*

Supply of soil water in per cent by volume	Control: untreated outwash sand	Similiar soil with 7% of syenitic granite
	Average content of K, mg per plant	
28	11.0	32.0
12	31.5	60.2
3	27.9	31.5

dition of syenite nearly doubled the growth of both crowns and roots of these seedlings. Syenite also increased stem diameter and adsorbing capacity of roots (the latter indicated by titration) .

Maximum growth of plants occurred at 12 percent moisture content, both in control and syenite-enriched soils. Syenite increased the average weight of seedlings by about 30 percent, however, it failed to alter significantly the gross morphology of the plants, their top-root ratio, or their root adsorbing capacity.

On the other hand, adding syenitic granite to soils with only 3 percent water in their surface layers proved ineffectual.

The differences in the growth of test plants are closely correlated with their content of foliar potassium (table 2). The position of the water table did rigidly control the length of root systems.

For nursery practice, the results suggest that to effectively replace soluble potash fertilizers by potassium-bearing silicates, such as syenite, feldspar, and micas, one must persistently maintain soil moisture near the field capacity.

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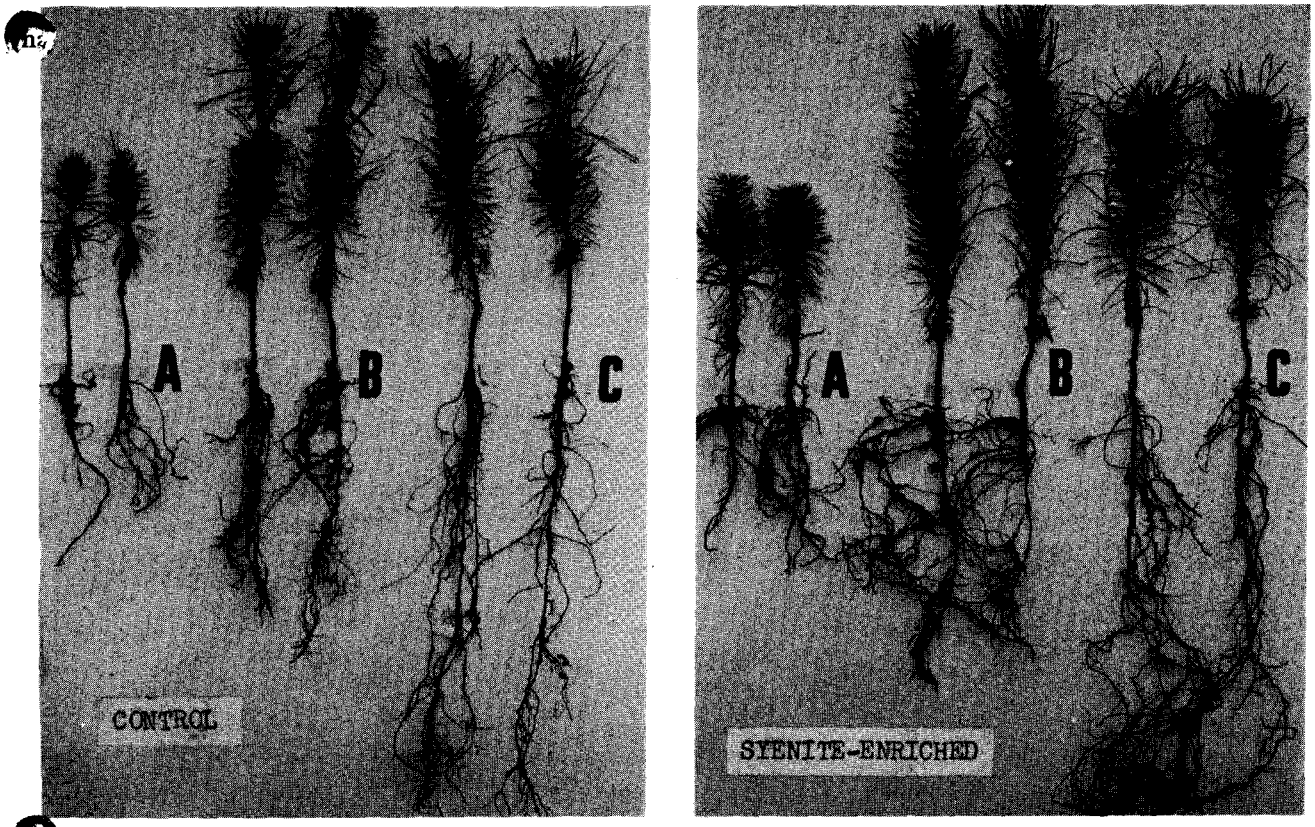

Figure 2.—Effect of 40-mesh syenite on the growth of 1-year-old Monterey pine seedlings raised at different soil moisture concentrations. *Left:* Untreated Sparta siliceous soil (A-1 horizon); *A*, 28 percent; *B*, 12 percent; *C*, 3 percent. *Right:* Similar soil enriched with 7 percent of syenitic granite containing 4.3 percent K_2O, with respective water supply for *A*, *B*, and *C* as for untreated samples. Note heavier top and root growth of excessively watered *A* seedlings at right which benefited from syenite treatment.