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EFFECTS OF SOIL AERATION ON PLANT GROWTH AND ROOT DEVELOPMENT

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Considerable is known concerning the immediate effect on root growth of excess carbon dioxide and shortage of oxygen in the soil. The ecologic importance of soil atmosphere in relation to root growth has also been studied. Very little work has been done on the formative and metabolic effects of continuous liberal soil aeration on plants so grown. A preliminary report is herewith presented of the formative effects of optimal air supply upon root and top growth in several types of plants whose roots differ in their oxygen requirements.

The soil in which certain aquatic and terrestial angiosperms were growing was slowly aerated daily for a period of one-half to five hours by means of compressed air supplied through perforate coils imbedded eight inches below the surface. *Helianthus, annuus, Triticum vulgare, Glycine soja, Linum usitatissimum* and cuttings of *Vitis vulpina* were grown in sand and in loam. At the age of two months conspicuous differences were apparent in aerated and unaerated plants on the same soil as well as between plants similarly treated but in different soils. As might be anticipated aeration did not produce the same effects in plants grown in loam and in sandy soil. Structural differences affected both tops and root systems, but especially the latter.

In general, roots in the aerated soils were distinctly fibrous in character, more numerous and longer, forming branches of secondary and tertiary rank. Total surface in aerated roots was twice or more that of control roots, but the root hair zone was smaller. Fewer hairs developed and these in turn were not as long-lived in aerated plants as in the controls caused by the more rapid elongation of the aerated roots. Vascular elements a few inches above the root hair zone were less developed in aerated roots.

The striking effect of aeration on tops was acceleration of growth in early stages, attributable to increased length of basal internodes rather than to an increase in the number. Contrast in internodal distance diminished noticeably, however, above the median nodes and there was little or no difference in size of internodes near the

tips. Elongation continued in controls after aerated plants had started to flower. This response tended to reduce size differences when mature plants of both groups were compared. The physiological effect of aeration on tops appeared to be acceleration in development with earlier maturation rather than prolonged development and increase in bulk. Percentage dry weight of top was the same in tops of aerated and unaerated plants.

B. E. Dean working in this laboratory under the author's direction has found that root systems of submerged aquatics, such as Typha, Sagittaria, and Hibiscus increase greatly in size in aerated sand, clay and muck. Roots in aerated soils were longer, more highly differentiated as shown by heavy lignification of the new primary roots in many cases. In the main, unaerated roots were fibrous but less numerous than the corresponding fibrous elements of aerated root systems. Submerged (but not subterranean) water roots of Typha and Sagittaria were more numerous and profusely branched in unaerated soils. In every case larger tops were associated with more extensive root systems.

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