References

- Abell, C. A., and Hursh, C. R. (1931). Positive gas and water pressures in oaks. Science 73, 449.
- Acevedo, E., Hsiao, T. C., and Henderson, D. W. (1971). Immediate and subsequent growth responses of maize leaves to changes in water status. *Plant Physiol.* 48, 631-636.
- Ackerson, R. C. (1980). Stomatal response of cotton to water stress and abscisic acid as affected by water stress history. *Plant Physiol.* 65, 455–459.
- Ackerson, R. C., and Hebert, R. R. (1981). Osmoregulation in cotton in response to water stress. I. Alterations in photosynthesis, leaf conductance, translocation, and ultrastructure. *Plant Physiol.* 67, 484–488.
- Ackerson, R. C., and Krieg, D. R. (1977). Stomatal and nonstomatal regulation of water use in cotton, corn and sorghum. *Plant Physiol.* 60, 850-853.
- Adams, S., Strain, B. R., and Adams, M. S. (1970). Water-repellent soils, fire, and annual plant cover in a desert scrub community of southeastern California. *Ecology* 51, 696-700.
- Adamsen, F. J. (1992). Irrigation method and water quality effects on corn yield in the mid-Atlantic coastal plain. Agron. J. 84, 837-843.
- Addoms, R. M. (1946). Entrance of water into suberized roots of trees. *Plant Physiol.* 21, 109-111.
- Aesbacher, R. A., Schiefelbein, J. W., and Benfey, P. N. (1994). The genetic and molecular basis of root development. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 45, 25-45.
- Aldrich, W. W., Work, R. A., and Lewis, M. R. (1935). Pear root concentration in relation to soil-moisture extraction in heavy clay soil. J. Agric. Res. (Washington, D.C.) 50, 975-988.
- Alieva, S. A., Tageeva, S. V., Tairbekov, M. G., Kasatkina, V. S., and Vagabova, M. E. (1971). Structural and functional condition of the chloroplasts as a function of the water regime. Sov. Plant Physiol. 18, 416-422.
- Altus, D. P., and Canny, M. J. (1985). Water pathways in wheat leaves. I. The division of fluxes between different vein types. Aust. J. Plant Physiol. 12, 173-181.
- Alvim, P. deT. (1960). Moisture stress as a requirement for flowering of coffee. Science 132, 354.
- Alvim, P. deT. (1965). A new type of porometer for measuring stomatal opening and its use in irrigation studies. UNESCO Arid Zone Res. 25, 325-329.

- Alvim, P. deT. (1985). Theobroma cacao. *In* "Handbook of Flowering" (A. H. Halevy, ed.), Vol. V, pp. 357–365. CRC Press, Boca Raton, FL.
- Alvim, P. deT., and Havis, J. R. (1954). An improved infiltration series for studying stomatal opening as illustrated with coffee. *Plant Physiol.* 29, 97-98.
- Amato, I. (1992). A new blueprint for water's architecture. Science 256, 1764.
- Amthor, J. S. (1989). "Respiration and Crop Productivity." Springer-Verlag, New York.
- Anderson, C. P., Markhart, A. H., III, Dixon, R. K., and Sucoff, E. L. (1988). Root hydraulic conductivity of vesicular-arbuscular mycorrhizal green ash seedlings. New Phytol. 109, 465-471.
- Anderson, L. E., and Bourdeau, P. F. (1955). Water relations in two species of terrestrial mosses. *Ecology* 36, 206-212.
- Anderson, M. C. (1981). The geometry of leaf distribution in some south-eastern Australian forests. Agric. Meteorol. 25, 195–205.
- Andrews, D. L., Cobb, B. G., Johnson, J. R., and Drew, M. C. (1993). Hypoxic and anoxic induction of alcohol dehydrogenase in roots and shoots of seedlings of *Zea mays. Plant Physiol.* 101, 407–414.
- Andrews, D. L., Drew, M. C., Johnson, J. R., and Cobb, B. G. (1994). The response of maize seedlings of different ages to hypoxic and anoxic stress. *Plant Physiol.* 105, 53-60.
- Andrews, F. C. (1976). Colligative properties of simple solutions. Science 194, 567-571.
- Andrews, R. E., and Newman, E. I. (1968). The influence of root pruning on the growth and transpiration of wheat under different soil moisture conditions. *New Phytol.* 67, 617–630.
- Anthon, G. E., and Jagendorf, A. T. (1983). Effect of methanol on spinach thylakoid ATPase. Biochim. Biophys. Acta 723, 358-365.
- Antolín, M. C., and Sánchez-Díaz, M. (1993). Effects of temporary droughts on photosynthesis of alfalfa plants. J. Exp. Bot. 44, 1341-1349.
- Aparicio-Tejo, P. M., and Boyer, J. S. (1983). Significance of accelerated leaf senescence at low water potentials for water loss and grain yield in maize. *Crop Sci.* 23, 1198–1202.
- Aphalo, P. J., and Jarvis, P. G. (1991). Do stomata respond to relative humidity? *Plant Cell Environ.* 14, 127–132.
- Armenta-Soto, J., Chang, T. T., Loresto, G. C., and O'Toole, J. C. (1983). Genetic analysis of root characters in rice. Sabrao J. 15, 103–116.
- Armstrong, J., and Armstrong, W. (1991). A convective through-flow of gases in *Phragmites australis* (Cav.) Trin. ex Steud. *Aquatic Bot.* 39, 75-88.
- Armstrong, J., Armstrong, W., and Beckett, P. M. (1992). *Phragmites australis:* Venturi and humidity-induced pressure flows enhance rhizome aeration and rhizosphere oxidation. *New Phytol.* 120, 197–207.
- Armstrong, W. (1968). Oxygen diffusion from the roots of woody species. *Physiol. Plant.* 21, 539–543.
- Armstrong, W., Justin, S. H. F. W., Beckett, P. M., and Lythe, S. (1991). Root adaptation to soil waterlogging. *Aquatic Bot.* 39, 57-73.
- Arndt, C. H. (1945). Temperature-growth relations of the roots and hypocotyls of cotton seedlings. Plant Physiol. 20, 200–220.
- Arntzen, C. J., Haugh, M. F., and Bobick, S. (1973). Induction of stomatal closure by Helminthosporium maydis pathotoxin. Plant Physiol. 52, 569-574.
- Ashton, F. M. (1956). Effects of a series of cycles of alternating low and high soil water contents on the rate of apparent photosynthesis in sugar cane. *Plant Physiol.* 31, 266–274.
- Askenasy, E. (1895). Ueber das saftsteigen. Bot. Centrbl. 62, 237-238.
- Assmann, S. M., and Grantz, D. A. (1990). Stomatal response to humidity in sugarcane and soybean: Effect of vapour pressure difference on the kinetics of the blue light response. *Plant Cell Environ.* 13, 163–169.
- Atkins, W. R. G. (1916). "Some Recent Researches in Plant Physiology." Whitaker and Co., London.

- Auchter, E. C. (1923). Is there normally a cross transfer of foods, water, and mineral nutrients in woody plants? Md. Agr. Exp. Sta. Bull. 257.
- Augé, R. M., and Duan, X. (1991). Mycorrhizal fungi and nonhydraulic root signals of soil drying. Plant Physiol. 97, 821–824.
- Avery, G. S., Jr. (1933). Structure and development of the tobacco leaf. Am. J. Bot. 20, 565-592.
- Axelsson, E., and Axelsson, B. (1986). Changes in carbon allocation patterns in spruce and pine trees following irrigation and fertilization. *Tree Physiol.* 2, 189–204.
- Aylor, D. E., Parlange, J.-Y., and Krikorian, A. D. (1973). Stomatal mechanics. Am. J. Bot. 60, 163-171.
- Ayres, P. G., and Boddy, L., eds. (1986). "Water, Fungi, and Plants." Cambridge University Press, Cambridge, England.
- Azaizeh, H., Gunse, B., and Steudle, E. (1992). Effects of NaCl and CaCl₂ on water transport across root cells of maize (*Zea mays L.*) seedlings. *Plant Physiol.* 99, 886–894.
- Azevedo, J., and Morgan, D. L. (1974). Fog precipitation in coastal California forests. *Ecology* 55, 1135-1141.
- Baarstad, L. L., Rickman, R. W., Wilkins, D., and Morita, S. (1993). A hydraulic soil sample providing minimum field plot disruption. *Agron. J.* 85, 178-181.
- Baker, J. M., and Van Bavel, C. H. M. (1986). Resistance of plants roots to water loss. Agron. J. 78, 641-644.
- Baldocchi, D. D., Luxmoore, R. J., and Hatfield, J. L. (1991). Discerning the forest from the trees: An essay on scaling canopy stomatal conductance. *Agric. For. Meteorol.* **54**, 197–226.
- Ball, J. T., and Berry, J. A. (1982). The C_i-C_s ratio: A basis for predicting stomatal control of photosynthesis. *Carnegie Inst. Washington Yearbook* 81, 88-92.
- Ball, J. T., Woodrow, I. E., and Berry, J. A. (1987). A model predicting stomatal conductance and its contribution to the control of photosynthesis under different environmental conditions. *In* "Progress in Photosynthesis research" (J. Biggins, ed.), Vol. 4, pp. 221–224. Nijhoff, Dordrecht.
- Balling, A., and Zimmermann, U. (1990). Comparative measurements of the xylem pressure of *Nicotiana* plants by means of the pressure bomb and pressure probe. *Planta* 182, 325-338.
- Bambach, R. K., Scotese, C. R., and Ziegler, A. M. (1980). Before Pangea: The geographies of the paleozoic world. Am. Sci. 68, 26-38.
- Bange, G. G. J. (1953). On the quantitative explanation of stomatal transpiration. *Acta Bot. Neerl.* 2, 255-297.
- Barber, D. A., Ebert, M., and Evans, N. T. S. (1962). The movement of ¹⁵O through barley and rice plants. J. Exp. Bot. 13, 397-403.
- Barber, D. A., and Martin, J. K. (1976). The release of organic substances by cereal roots. New Phytol. 76, 69-80.
- Barber, S. A. (1962). A diffusion and mass-flow concept of soil nutrient availability. Soil Sci. 93, 39-49.
- Barber, S. A., Walker, J. M., and Vasey, E. H. (1962a). Principles of ion movement through the soil to the plant root. *In* "Transactions of the International Society of Soil Science, Commissions IV and V," pp. 121–124. International Soil Conference, Soil Bureau, P. B. Lower Hutt, New Zealand, 1963.
- Barber, S. A., Walker, J. M., and Vasey, E. H. (1962b). Mechanisms for the movement of plant nutrients from the soil and fertilizer to the plant roots. J. Agric. Food Chem. 11, 204-207.
- Bardzik, J. M., Marsh, H. V., Jr., and Havis, J. R. (1971). Effects of water stress on the activities of three enzymes in maize seedlings. *Plant Physiol.* 47, 828-831.
- Barley, K. P. (1962). The effect of mechanical stress on the growth of roots. J. Exp. Bot. 13, 95-110.
- Barley, K. P. (1970). The configuration of the root system in relation to nutrient uptake. Adv. Agron. 22, 159-201.

- Barlow, E. W. R. (1986). Water relations of expanding leaves. Aust. J. Plant Physiol. 13, 45-58.
- Barlow, E. W. R., Ching, T. M., and Boersma, L. (1976). Leaf growth in relation to ATP levels in water stressed corn plants. *Crop Sci.* 16, 405-407.
- Barlow, E. W. R., Lee, J. W., Munns, R., and Smart, M. G. (1980). Water relations of the developing wheat grain. Aust. J. Plant Physiol. 7, 519-525.
- Barney, C. W. (1951). Effects of soil temperature and light intensity on root growth of loblolly pine seedlings. *Plant Physiol.* 26, 146-163.
- Baron-Epel, O., Gharyal, P. K., and Schindler, M. (1988). Pectins as mediators of wall porosity in soybean cells. *Planta* 175, 389-395.
- Barrs, H. D. (1968). Effect of cyclic variations in gas exchange under constant environmental conditions on the ratio of transpiration to net photosynthesis. *Physiol. Plant.* 21, 918–929.
- Barrs, H. D. (1971). Cyclic variations in stomatal aperture, transpiration, and leaf water potential under constant environmental conditions. Annu. Rev. Plant Physiol. 22, 223-236.
- Barrs, H. D., and Klepper, B. (1968). Cyclic variations in plant properties under constant environmental conditions. *Physiol. Plant.* 21, 711-730.
- Barta, A. L. (1984). Ethanol synthesis and loss from flooded roots of Medicago sativa L. and Lotus corniculatus L. Plant Cell Environ. 7, 187-191.
- BassiriRad, H., and Radin, J. W. (1992). Temperature-dependent water and ion transport properties of barley and sorghum roots. II. Effects of abscisic acid. Plant Physiol. 99, 34-37.
- BassiriRad, H., Radin, J. W., and Matsuda, K. (1991). Temperature-dependent water and ion transport properties of barley and sorghum roots. I. Relationship to leaf growth. *Plant Physiol.* 97, 426-432.
- Bates, L. M., and Hall, A. E. (1981). Stomatal closure with soil water depletion not associated with changes in bulk leaf water status. *Oecologia* 50, 62–65.
- Baver, L. D. (1948). "Soil Physics," 2nd Ed. Wiley, New York.
- Baxter, P., and West, D. (1977). The flow of water into fruit trees. II. Water intake through a cut limb. Ann. Appl. Biol. 87, 103-112.
- Bayliss, W. M. (1924). "Principles of General Physiology," 4th Ed., Chap. 8. Longmans, Green and Co., London.
- Beardsell, M. F., and Cohen, D. (1975). Relationships between leaf water status, abscisic acid levels, and stomatal resistance in maize and sorghum. *Plant Physiol.* 56, 207–212.
- Beardsell, M. F., Jarvis, P. G., and Davidson, B. (1972). A null-balance diffusion porometer suitable for use with leaves of many shapes. *J. Appl. Ecol.* 9, 677–690.
- Beasley, E. W. (1942). Effects of some chemically inert dusts upon the transpiration rate of yellow coleus plants. *Plant Physiol.* 17, 101-108.
- Beasley, R. S. (1976). Contribution of subsurface flow from the upper slopes of forested watersheds to channel flow. Soil Sci. Soc. Am. Proc. 40, 955-957.
- Beevers, L., and Hageman, R. H. (1969). Nitrate reduction in higher plants. Annu. Rev. Plant Physiol. 20, 495-522.
- Beevers, L., and Hageman, R. H. (1983). Uptake and reduction of nitrate: bacteria and higher plants. *In* "Encyclopedia of Plant Physiology" (A. Läuchli and R. L. Bieleski, eds.), Vol. 15A, pp. 351-375. Springer-Verlag, Berlin.
- Beevers, L., Schrader, L. E., Flesher, D., and Hageman, R. H. (1965). The role of light and nitrate in the induction of nitrate reductase in radish cotyledons and maize seedlings. *Plant Physiol.* 40, 691-698.
- Bell, D. T., Koeppe, D. E., and Miller, R. J. (1971). The effects of drought stress on respiration of isolated corn mitochondria. *Plant Physiol.* 48, 413-415.
- Benfey, P. N., and Schiefelbein, J. W. (1994). Insights into root development from *Arabidopsis* root mutants. *Plant Cell Environ.* 17, 675-680.
- Bengough, A. G., and Mullins, C. E. (1991). The resistance experienced by roots growing in a pressurized cell. *Plant Soil* 123, 73-82.

- Bengtson, C., Larsson, S., and Liljenberg, C. (1978). Effects of water stress on cuticular transpiration rate and amount and composition of epicuticular wax in seedlings of six oat varieties. *Physiol. Plant.* 44, 319–324.
- Bennett, O. L., and Doss, B. D. (1960). Effect of soil moisture level on root distribution of coolseason forage species. *Agron. J.* 52, 204-207.
- Bensen, R. J., Boyer, J. S., and Mullet, J. E. (1988). Water deficit-induced changes in abscisic acid content, growth, polysomes, and translatable RNA in soybean hypocotyls. *Plant Physiol.* 88, 289-294.
- Benson, S. W., and Siebert, E. D. (1992). A simple two-structure model for liquid water. J. Am. Chem. Soc. 114, 4269-4276.
- Bental, M., Degani, H., and Avron, M. (1988a). ²³Na-NMR studies of the intracellular sodium ion concentration in the halotolerant alga *Dunaliella salina*. *Plant Physiol.* 87, 813–817.
- Bental, M., Oren-Shamir, M., Avron, M., and Degani, H. (1988b). ³¹P and ¹³C-NMR studies of the phosphorus and carbon metabolites in the halotolerant alga, *Dunaliella salina*. *Plant Physiol.* 87, 320–324.
- Berkowitz, G. A., and Kroll, K. S. (1988). Acclimation of photosynthesis in *Zea mays* to low water potentials involves alterations in protoplast volume reduction. *Planta* 175, 374-379.
- Berkowitz, G. A., and Whalen, C. (1985). Leaf K⁺ interaction with water stress inhibition of nonstomatal-controlled photosynthesis. *Plant Physiol.* 79, 189-193.
- Bernal, J. D. (1965). The structure of water and its biological implications. Symp. Soc. Exp. Biol. 19, 17-32.
- Bernstein, L. (1961). Osmotic adjustment of plants to saline media. I. Steady state. Am. J. Bot. 48, 909-918.
- Bernstein, L., Gardner, W. R., and Richards, L. A. (1959). Is there a vapor gap around roots? Science 129, 1750-1753.
- Berry, L. J. (1949). The influence of oxygen on the respiratory rate in different segments of onion roots. J. Cell Comp. Physiol. 33, 41-66.
- Bethlenfalvay, G. J., Brown, M. S., Mihara, K. L., and Stafford, A. E. (1987). Glycine-Glomus-Rhizobium symbiosis. V. Effects of mycorrhiza on nodule activity and transpiration in soybeans under drought stress. Plant Physiol. 85, 115-119.
- Bewley, J. D. (1979). Physiological aspects of desiccation tolerance. Annu. Rev. Plant Physiol. 30, 195-238.
- Bewley, J. D., and Larsen, K. M. (1982). Differences in the responses to water stress of growing and non-growing regions of maize mesocotyls: Protein synthesis on total, free and membrane-bound polyribosome fractions. *J. Exp. Bot.* 33, 406-415.
- Bewley, J. D., and Pacey, J. (1978). Desiccation-induced ultrastructural changes in drought-sensitive and drought-tolerant plants. *In* "Dry Biological Systems" (J. H. Crowe and J. S. Clegg, eds.), pp. 53-73. Academic Press, New York.
- Beyschlag, W., and Pfanz, H. (1990). A fast method to detect the occurrence of nonhomogeneous distribution of stomatal aperture in heterobaric plant leaves: Experiments with *Arbutus unedo* L. during the diurnal course. *Oecologia* 82, 52-55.
- Beyschlag, W., Pfanz, H., and Ryel, R. J. (1992). Stomatal patchiness in Mediterranean evergreen sclerophylls. *Planta* 187, 546-553.
- Beyschlag, W., Phibbs, A., and Pfanz, H. (1990). The role of temperature and humidity in controlling the diurnal stomatal behavior of *Arbutus unedo* L. during the dry season. *Biochem. Physiol. Pflanzen* 186, 265–271.
- Bhat, K. K. S., and Nye, P. H. (1974). Diffusion of phosphate to plant roots in soil. II. Uptake along the roots at different times and the effect of different levels of phosphorus. *Plant Soil* 41, 365-382.
- Bialzyk, J., and Lechowski, L. (1992). Absorption of HCO₃ by roots and its effect on carbon metabolism of tomato. *J. Plant Nutr.* 15, 293–312.

- Bible, B. B., Cuthbert, R. L., and Corolus, R. L. (1968). Responses of some vegetable crops to atmospheric modifications under field conditions. J. Am. Soc. Hortic. Sci. 92, 590-594.
- Bierhuizen, J. F., and Slatyer, R. O. (1965). Effect of atmospheric concentration of water vapor and CO₂ in determining transpiration-photosynthesis relationships of cotton leaves. *Agric. Meteorol.* 2, 259-270.
- Biles, C. L., and Abeles, F. B. (1991). Xylem sap proteins. Plant Physiol. 96, 597-601.
- Billings, W. D. (1978). "Plants and the Ecosystem." Wadsworth, Belmont, CA.
- Billings, W. D., and Godfrey, P. J. (1967). Photosynthetic utilization of internal carbon dioxide by hollow-stemmed plants. Science 158, 121-123.
- Bingham, E. C., and Jackson, R. F. (1918). Standard substances for the calibration of viscometers. Bull. Bureau Standards 14, 59-86.
- Bingham, L. J., and Stevenson, E. A. (1993). Control of root growth: Effects of carbohydrates on the extension, branching and rate of respiration of different fractions of wheat roots. *Physiol. Plant.* 88, 149–158.
- Bisson, M. A., and Bartholomew, D. (1984). Osmoregulation or turgor regulation in *Chara? Plant Physiol.* 74, 252-255.
- Biswell, H. H. (1935). Effect of the environment upon the root habits of certain deciduous forest trees. *Bot. Gaz.* (Chicago) 96, 676-708.
- Björkman, E. (1942). Über die Bedingungen der Mykorrhizabildung bei Kiefer und Fichts. Symb. Bot. Ups. 6, 1-190.
- Björkman, O. (1981). Responses to different quantum flux densities. *In* "Encyclopedia of Plant Physiology" (O. L. Lange, P. S. Nobel, C. B. Osmond, and H. Ziegler, eds.), Vol. 12A, p. 57. Springer-Verlag, Berlin.
- Björkman, O., and Powles, S. B. (1984). Inhibition of photosynthetic reactions under water stress: Interaction with light level. *Planta* 161, 490–504.
- Black, C. R. (1979a). The relationship between transpiration rate, water potential, and resistances to water movement in sunflower (*Helianthus annuus L.*). J. Exp. Bot. 30, 235-243.
- Black, C. R. (1979b). The relative magnitude of the partial resistances to transpirational water movement in sunflower (Helianthus annuus L.). J. Exp. Bot. 30, 245-253.
- Blackman, P. G., and Davies, W. J. (1985). Root to shoot communications in maize plants of the effects of soil drying. J. Exp. Bot. 36, 39-48.
- Blake, G. R., Allred, E. R., Van Bavel, C. H. M., and Whisler, F. D. (1960). Agricultural drought and moisture excesses in Minnesota. Univ. Minn. Tech. Bull. 235.
- Blizzard, W. E., and Boyer, J. S. (1980). Comparative resistance of the soil and the plant to water transport. *Plant Physiol.* 66, 809-814.
- Bloodworth, J. E., Page, J. B., and Cowley, W. R. (1956). Some applications of the thermoelectric method for measuring water flow in plants. *Agron. J.* 48, 222-228.
- Blum, A. (1979). Genetic improvement of drought resistance in crop plants: A case for sorghum. In "Stress Physiology in Crop Plants" (H. Mussell and R. C. Staples, eds.), pp. 429-445. Wiley, New York.
- Blum, A., Johnson, J. W., Ramseur, E. L., and Tollner, E. W. (1991). The effect of a drying top soil and a possible non-hydraulic root signal on wheat growth and yield. *J. Exp. Bot.* 42, 1225–1231.
- Blum, A., Schertz, K. F., Toler, R. W., Welch, R. I., Rosenow, D. T., Johnson, J. W., and Clark, L. E. (1978). Selection for drought avoidance in sorghum using aerial infra-red photography. Agron. J. 70, 472-477.
- Böhm, J. (1893). Capillarität und Saftsteigen. Ber. Dtsch. Bot. Ges. 11, 203-212.
- Böhm, W. (1979). "Methods of Studying Root Systems." Springer-Verlag, Berlin.
- Bolaños, J., and Edmeades, G. O. (1993a). Eight cycles of selection for drought tolerance in lowland tropical maize. I. Responses in grain yield, biomass, and radiation utilization. *Field Crops Res.* 31, 233–252.

- Bolaños, J., and Edmeades, G. O. (1993b). Eight cycles of selection for drought tolerance in lowland tropical maize. II. Responses in reproductive behavior. Field Crops Res. 31, 253-268.
- Bolaños, J., Edmeades, G. O., and Martinez, L. (1993). Eight cycles of selection for drought tolerance in lowland tropical maize. III. Responses in drought-adaptive physiological and morphological traits. Field Crops Res. 31, 269-286.
- Bole, J. B. (1973). Influence of root hairs in supplying soil phosphorus to wheat. Can J. Soil Sci. 53, 169-175.
- Bollard, E. G. (1960). Transport in the xylem. Annu. Rev. Plant Physiol. 11, 141-166.
- Bonner, J. (1934). Studies on the growth hormone of plants. V. The relation of cell elongation to cell wall formation. *Proc. Natl. Acad. Sci. USA* 20, 393–397.
- Bonner, J. (1959). Water transport. Science 129, 447-450.
- Booker, F. L., Blum, U., and Fiscus, E. L. (1992). Short-term effects of ferulic acid on ion uptake and water relations in cucumber seedlings. J. Exp. Bot. 43, 649-655.
- Borchert, R. (1973). Simulation of rhythmic tree growth under constant conditions. *Physiol. Plant.* **29**, 173–180.
- Bordovsky, D. G., Jordan, W. R., Hiler, E. A., and Howell, T. A. (1974). Choice of irrigation timing indicator for narrow row cotton. *Agron. J.* 66, 88-91.
- Borghetti, M., Edwards, W. R. N., Grace, J., Jarvis, P. G., and Raschi, A. (1991). The refilling of embolized xylem in *Pinus sylvestris* L. *Plant Cell Environ.* 14, 357-369.
- Bormann, F. H. (1957). Moisture transfer between plants through intertwined root systems. *Plant Physiol.* 32, 48-55.
- Bormann, F. H., and Graham, B. F., Jr. (1959). The occurrence of natural root grafting in eastern white pine, *Pinus strobus* L., and its ecological implications. *Ecology* 40, 677-691.
- Bormann, F. H., and Graham, B. F. (1960). Translocation of silvicides through root grafts. *J. For.* 58, 402-403.
- Bosch, J. M., and Hewlett, J. D. (1982). A review of catchment experiments to determine the effect of vegetation changes on water yield and evaporation. J. Hydrol. (Amsterdam) 55, 3-23.
- Bose, J. C. (1923). "Physiology of the Ascent of Sap." Longmans Green and Co., London.
- Bothe, H., Yates, M. G., and Cannon, F. C. (1983). Physiology, biochemistry and genetics of dinitrogen fixation. *In* "Encyclopedia of Plant Physiology" (A. Läuchli and R. L. Bieleski, eds.), Vol. 15A, pp. 241–285. Springer-Verlag, Berlin/Heidelberg.
- Bottomley, P. A., Rogers, H. H., and Prior, S. A. (1993). NMR imaging of root water distribution in intact *Vicia faba* L. plants in elevated atmospheric CO₂. *Plant Cell Environ.* 16, 335–338.
- Boucherie, A. (1840). Rapport sur une mémoire de M. le docteur Boucherie relatif à la conservation des bois. *Compt. Rendus* 10, 685-689.
- Bouma, J. (1991). Influence of soil macroporosity on environmental quality. Adv. Agron. 46, 1–37. Bouma, J., Belmans, C. F. M., and Dekker, L. W. (1982). Water infiltration and redistribution in a silt loam subsoil with vertical worm channels. Soil Sci. Soc. Am. J. 46, 917–921.
- Bouyoucos, G. J. (1954). New type electrode for plaster of paris moisture blocks. Soil Sci. 78, 339-342.
- Bowen, G. D. (1984). Tree roots and the use of soil nutrients. *In* "Nutrition of Plantation Forests" (G. D. Bowen and E. K. S. Nambier, eds.), pp. 147-179. Academic Press, London.
- Bowes, G. (1993). Facing the inevitable: Plants and increasing atmospheric CO₂. Annu. Rev. Plant Physiol. Plant Mol. Biol. 44, 309-332.
- Bowling, D. J. F. (1973). Measurement of a gradient of oxygen partial pressure across the intact root. *Planta* 111, 323-328.
- Bowman, W. D., Hubick, K. T., von Caemmerer, S., and Farquhar, G. (1989). Short-term changes in leaf carbon isotope discrimination in salt- and water-stressed C₄ grasses. *Plant Physiol.* 90, 162-166.
- Box, J. E., Jr., and Hammond, L. C., eds. (1990). "Rhizosphere Dynamics." Westview Press, Boulder, CO.

- Box, J. E., Jr., and Ramseur, E. L. (1993). Minirhizotron wheat root data: Comparisons to soil core root data. Agron. J. 85, 1058-1060.
- Boyce, S. G. (1954). The salt spray community Ecol. Monogr. 24, 29-67.
- Boyer, J. S. (1965). Effects of osmotic water stress on metabolic rates of cotton plants with open stomata. *Plant Physiol.* 40, 229-234.
- Boyer, J. S. (1967a). Leaf water potentials measured with a pressure chamber. *Plant Physiol.* 42, 133-137.
- Boyer, J. S. (1967b). Matric potentials of leaves. Plant Physiol. 42, 213-217.
- Boyer, J. S. (1968). Relationship of water potential to growth of leaves. *Plant Physiol.* 43, 1056–1062.
- Boyer, J. S. (1969). Free-energy transfer in plants. Science 163, 1219-1220.
- Boyer, J. S. (1970). Leaf enlargement and metabolic rates in corn, soybean, and sunflower at various leaf water potentials. *Plant Physiol.* 46, 233–235.
- Boyer, J. S. (1971a). Nonstomatal inhibition of photosynthesis in sunflower at low leaf water potentials and high light intensities. *Plant Physiol.* 48, 532–536.
- Boyer, J. S. (1971b). Recovery of photosynthesis in sunflower after a period of low leaf water potential. *Plant Physiol.* 47, 816–820.
- Boyer, J. S. (1971c). Resistances to water transport in soybean, bean and sunflower. *Crop Sci.* 11, 403-407.
- Boyer, J. S. (1973). Response of metabolism to low water potentials in plants. *Phytopathology* 63, 466-472.
- Boyer, J. S. (1974). Water transport in plants: mechanism of apparent changes in resistance during absorption. *Planta* 117, 187–207.
- Boyer, J. S. (1977). Regulation of water movement in whole plants. Soc. Expt. Biol. Symp. 31, 455-470.
- Boyer, J. S. (1982). Plant productivity and environment. Science 218, 443-448.
- Boyer, J. S. (1983). Subcellular mechanisms of plant response to low water potential. Agricultural Water Management 7, 239-248.
- Boyer, J. S. (1985). Water transport. Annu. Rev. Plant Physiol. 36, 473-516.
- Boyer, J. S. (1988). Cell enlargement and growth-induced water potentials. *Physiol. Plant.* 73, 311-316.
- Boyer, J. S. (1989). Water potential and plant metabolism: Comments on Dr. P. J. Kramer's article "Changing concepts regarding plant water relations," Vol. 11, Number 7, pp. 565-568, and Dr. J. B. Passioura's response, pp. 569-571. Plant Cell Environ. 12, 213-216.
- Boyer, J. S. (1990). Photosynthesis in dehydrating plants. Bot. Mag. Tokyo Special Issue 2, 73-85.
- Boyer, J. S. (1993). Temperature and growth-induced water potential. *Plant Cell Environ.* 16, 1099-1106.
- Boyer, J. S. (1995). "Measuring the Water Status of Plants and Soil." Academic Press, San Diego.
- Boyer, J. S., and Bowen, B. L. (1970). Inhibition of oxygen evolution in chloroplasts isolated from leaves with low water potentials. *Plant Physiol.* 45, 612-615.
- Boyer, J. S., Cavalieri, A. J., and Schulze, E.-D. (1985). Control of cell enlargement: Effects of excision, wall relaxation, and growth-induced water potentials. *Planta* 163, 527-543.
- Boyer, J. S., Johnson, R. R., and Saupe, S. G. (1980). Afternoon water deficits and grain yields in old and new soybean cultivars. *Agron. J.* 72, 981–986.
- Boyer, J. S., and Knipling, E. B. (1965). Isopiestic technique for measuring leaf water potentials with a thermocouple psychrometer. *Proc. Natl. Acad. Sci. USA* 54, 1044–1051.
- Boyer, J. S., and McPherson, H. G. (1975). Physiology of water deficits in cereal crops. Adv. Agron. 27, 1–23.
- Boyer, J. S., and Potter, J. R. (1973). Chloroplast response to low leaf water potentials. I. Role of turgor. *Plant Physiol.* 51, 989–992.

- Boyle, M. G., Boyer, J. S., and Morgan, P. W. (1991a). Stem infusion of maize plants. Crop Sci. 31, 1241-1245.
- Boyle, M. G., Boyer, J. S., and Morgan, P. W. (1991b). Stem infusion of liquid culture medium prevents reproductive failure of maize at low water potentials. *Crop Sci.* 31, 1246–1252.
- Bozarth, C. S., Mullet, J. E., and Boyer, J. S. (1987). Cell wall proteins at low water potentials. *Plant Physiol.* 85, 261-267.
- Bradford, K. J. (1994). Water stress and the water relations of seed development: A critical review. Crop Sci. 34, 1-11.
- Bradford, K. J., and Yang, S. F. (1980). Xylem transport of 1-aminocyclopropane-1-carboxylic acid, an ethylene precursor, in waterlogged tomato plants. *Plant Physiol.* 65, 322-326.
- Bradshaw, A. D. (1965). Evolutionary significance of phenotypic plasticity in plants. Adv. Genetics 13, 115-155.
- Bray, E. A. (1988). Drought- and ABA-induced changes in polypeptide and mRNA accumulation in tomato leaves. *Plant Physiol.* 88, 1210-1214.
- Bray, J. R. (1963). Root production and the estimation of net productivity. Can. J. Bot. 41, 65-72.
- Breazeale, E. L., and McGeorge, W. T. (1953). Exudation pressure in roots of tomato plants under humid conditions. *Soil Sci.* 75, 293–298.
- Bremner, P. M., Preston, G. K., and Fazekas de St. Groth, C. (1986). A field comparison of sunflower (*Helianthus annuus*) and sorghum (*Sorghum bicolor*) in a long drying cycle. I. Water extraction. *Aust. J. Agr. Res.* 37, 483-493.
- Bresler, E. (1977). Trickle-drip irrigation: Principles and application to soil-water management. *Adv. Agron.* 29, 344-393.
- Bret-Harte, M. S., Baskin, T. I., and Green, P. B. (1991). Auxin stimulates both deposition and breakdown of material in the pea outer epidermal cell wall, as measured interferometrically. *Planta* 185, 462-471.
- Bret-Harte, M. S., and Silk, W. K. (1994). Nonvascular, symplasmic diffusion of sucrose cannot satisfy the carbon demands of growth in the primary root tip of *Zea mays L. Plant Physiol.* 105, 19-33.
- Brevedan, E. R., and Hodges, H. F. (1973). Effects of moisture deficits on ¹⁴C translocation in corn (*Zea mays* L.). *Plant Physiol.* **52**, 436–439.
- Briggs, L. J., and Shantz, H. L. (1911). A wax seal method for determining the lower limit of available soil moisture. *Bot. Gaz.* (Chicago) 51, 210–219.
- Briggs, L. J., and Shantz, H. L. (1912). The relative wilting coefficients for different plants. Bot. Gaz. 53, 229-235.
- Briggs, L. J., and Shantz, H. L. (1914). Relative water requirement of plants. J. Agric. Res. (Washington, DC) 3, 1-63.
- Brix, H. (1962). The effect of water stress on the rates of photosynthesis and respiration in tomato plants and loblolly pine seedlings. *Physiol. Plant.* 15, 10–20.
- Brix, H. (1990). Uptake and photosynthetic utilization of sediment-derived carbon by *Phragmites australis* (Cav.) Trin. ex Steudel. *Aquatic Bot.* 38, 377–389.
- Brouwer, R. (1965). Ion absorption and transport in plants. Annu. Rev. Plant Physiol. 16, 241-266.
- Brown, D. P., Pratum, T. K., Bledsoe, C., Ford, E. D., Cothren, J. S., and Perry, D. (1991). Noninvasive studies of conifer roots: Nuclear magnetic resonance (NMR) imaging of Douglas fir seedlings. Can. J. For. Res. 21, 1559–1566.
- Brown, E. M. (1939). Some effects of temperature on the growth and chemical composition of certain pasture grasses. Missouri Agr. Exp. Sta. Res. Bull. 299.
- Brown, H. I., and Escombe, F. (1900). Static diffusion of gases and liquids in relation to the assimilation of carbon and translocation of plants. *Phil. Trans. Roy. Soc. London Ser. B* 193, 223-291.

- Brown, J. M., Johnson, G. A., and Kramer, P. J. (1986). In vivo magnetic resonance microscopy of changing water content in *Pelargonium hortorum* roots. *Plant Physiol.* 82, 1158-1160.
- Brown, J. M., Kramer, P. J., Cofer, G. P., and Johnson, G. A. (1990). Use of nuclear magnetic resonance microscopy for noninvasive observations of root-soil water relations. *Theor. Appl. Climatol.* 42, 229–236.
- Brown, K. W., Jordan, W. R., and Thomas, J. C. (1976). Water stress induced alteration in the stomatal response to leaf water potential. *Plant Physiol.* 37, 1–5.
- Brown, K. W., and Rosenberg, N. J. (1973). A resistance model to predict evapotranspiration and its application to a sugar beet field. *Agron. J.* 65, 341–347.
- Brown, R. H., and Simmons, R. E. (1979). Photosynthesis of grass species differing in CO₂ fixation pathways. I. Water-use efficiency. *Crop Sci.* 19, 375–379.
- Brown, R. W., and Oosterhuis, D. M. (1992). Measuring plant and soil water potentials with thermocouple psychrometers: Some concerns. *Agron. J.* 84, 78–86.
- Brown, V. K., and Gange, A. C. (1991). Effects of root herbivory on vegetation dynamics. *In* "Plant Root Growth" (D. Atkinson, ed.), pp. 453-470. Blackwell, London.
- Brown, W. V., and Pratt, G. A. (1965). Stomatal inactivity in grasses. Southwestern Naturalist 10, 48-56.
- Brugnoli, E., Hubick, K. T., von Caemmerer, S., Wong, S. C., and Farquhar, G. D. (1988). Correlation between the carbon isotope discrimination in leaf starch and sugars of C₄ plants and the ratio of intercellular and atmospheric partial pressures of carbon dioxide. *Plant Physiol.* 88, 1418–1424.
- Brummell, D. A., and Hall, J. L. (1985). The role of cell wall synthesis in sustained auxin-induced growth. *Physiol. Plant.* 63, 406-412.
- Bruni, F., and Leopold, A. C. (1991). Hydration, protons and onset of physiological activities in maize seeds. *Physiol. Plant.* 81, 359–366.
- Buckland, S. T., Campbell, C. D., Mackie-Dawson, L. A., Horgan, G. W., and Duff, E. I. (1993). A method for counting roots observed in minirhizotrons and their theoretical conversion to root length density. *Plant Soil* 153, 1–9.
- Bunce, J. A. (1978). Effects of shoot environment on apparent root resistance to water flow in whole soybean and cotton plants. J. Exp. Bot. 29, 595-601.
- Bunce, J. A. (1981). Relationship between maximum photosynthetic rates and photosynthetic tolerance of low leaf water potentials. *Can. J. Bot.* 59, 769-774.
- Bunce, J. A., Miller, L. N., and Chabot, B. F. (1977). Competitive exploitation of soil water by five eastern North American tree species. *Bot. Gaz.* (Chicago) 138, 168-173.
- Bunger, M. T., and Thomson, H. J. (1938). Root development as a factor in the success or failure of windbreak trees in the southern high plains. *J. For.* 36, 790–803.
- Burger, D. W., Hartin, J. S., Hodel, D. R., Gukazewski, T. A., Tjosvold, S. A., and Wagner, S. A. (1987). Water use in California's ornamental nurseries. *Calif. Agric.* 41, 7–8.
- Burke, M. J., Bryant, R. G., and Weiser, C. J. (1974). Nuclear magnetic resonance of water in cold acclimating red osier dogwood stem. *Plant Physiol.* 54, 392-398.
- Burke, M. J., Gusta, L. V., Quamme, H. A., Weiser, C. J., and Li, P. H. (1976). Freezing and injury in plants. *Annu. Rev. Plant Physiol.* 27, 507-528.
- Burrows, W. J., and Carr, D. J. (1969). Effects of flooding the root system of sunflower plants on the cytokinin content in the xylem sap. *Physiol. Plant.* 22, 1105–1112.
- Burström, H. (1959). Growth and intercellularies in root meristems. *Physiol. Plant.* 12, 371–385. Burton G. W. DeVane, F. H. and Carter, R. I. (1954). Root penetration distribution and activity.
- Burton, G. W., DeVane, E. H., and Carter, R. L. (1954). Root penetration, distribution and activity in southern grasses measured by yields, drought symptoms and P³² uptake. *Agron. J.* 46, 229–233.
- Burton, G. W., Prine, G., M., and Jackson, J. E. (1957). Studies of drought tolerance and water use of several southern grasses. *Agron. J.* 49, 498-503.

- Buswell, A. M., and Rodebush, W. H. (1956). Water. Sci. Am. 194, 77-89.
- Byott, G. S., and Sheriff, D. W. (1976). Water movement into and through *Tradescantia virginiana* (L.) leaves. II. Liquid flow pathways and evaporative sites. J. Exp. Bot. 27, 634-639.
- Byrne, G. F., Begg, J. E., and Hansen, G. K. (1977). Cavitation and resistance to water flow in plant roots. *Agric. Meteorol.* 18, 21-25.
- Caffrey, M., Fonseca, V., and Leopold, A. C. (1988). Lipid-sugar interactions: Relevance to anhydrous biology. *Plant Physiol.* 86, 754–758.
- Caldwell, M. M., and Richards, J. H. (1989). Hydraulic lift: Water efflux from upper roots improves effectiveness of water uptake by deep roots. *Oecologia* 79, 1–5.
- Campbell, W. A., and Copeland, O. L. (1954). Little leaf disease of shortleaf and loblolly pines. U.S. Dept. Agric. Circ. 940.
- Cannell, R. Q., Belford, R. K., Gales, K., Thomson, R. J., and Webster, C. P. (1984). Effects of waterlogging and drought on winter wheat and winter barley grown on a clay and a sandy loam soil. *Plant Soil* 80, 53-66.
- Canny, M. J. (1990). What becomes of the transpiration stream? New Phytol. 114, 341-368.
- Canny, M. J., and Huang, C. X. (1993). What is in the intercellular spaces of roots? Evidence from the cryo-analytical-scanning microscope. *Physiol Plant.* 87, 561-568.
- Canny, M. J., and McCully, M. E. (1988). The xylem sap of maize roots: Its collection, composition, and formation. Aust. J. Plant Physiol. 15, 557-566.
- Cardon, Z. G., and Berry, J. (1992). Effects of O₂ and CO₂ concentration on the steady-state fluorescence yield of single guard cell pairs in intact leaf discs of *Tradescantia albiflora*. Plant Physiol. 99, 1238–1244.
- Cardon, Z. G., Berry, J. A., and Woodrow, I. E. (1994). Dependence on the extent and direction of average stomatal response in *Zea mays L.* and *Phaseolus vulgaris L.* on the frequency of fluctuations in environmental stimuli. *Plant Physiol.* 105, 1007–1013.
- Carlson, T. N., and Lynn, B. (1991). The effects of plant water storage on transpiration and radiometric surface temperatures. Agric. For. Meteorol. 57, 171–186.
- Carlson, W. C., Harrington, C. A., Farnum, P., and Hollgren, S. W. (1988). Effects of root severing treatments on loblolly pine. *Can. J. For. Res.* 18, 1376–1385.
- Carmi, A. (1993). Effects of root zone restriction on amino acid status and bean plant growth. J. Exp. Bot. 44, 1161–1166.
- Carmi, A., Hesketh, J. D., Enos, W. T., and Peters, D. B. (1983). Interrelationships between shoot growth and photosynthesis as affected by root growth restriction. *Photosynthesis* 17, 240–245.
- Carpita, N. C. (1982). Limiting diameters of pores and the surface structure of plant cell walls. *Science* 218, 813-814.
- Carpita, N. C., Sabularse, D., Montezinos, D., and Delmer, D. P. (1979). Determination of the pore size of cell walls of living plant cells. *Science* 205, 1144-1147.
- Carter, J. C. (1945). Wetwood of elms. Illinois Natural History Survey 23, 401-448.
- Cassel, D. K., and Klute, A. (1986). Water potential: Tensiometry. *In* "Methods of Soil Analysis" (A. Klute, ed.), Vol. 9, pp. 563-596. American Society of Agronomy, Madison, WI.
- Catska, V., Vancura, V., Hudska, G., and Prikryl, Z. (1982). Rhizosphere microorganisms in relation to the apple replant problem. *Plant Soil* 69, 187-197.
- Caughey, M. F. (1945). Water relations of pocosins or bog shrubs. Plant Physiol. 20, 671-689.
- Cavalieri, A. J., and Boyer, J. S. (1982). Water potentials induced by growth in soybean hypocotyls. *Plant Physiol.* **69**, 492–496.
- Cermák, J., Cienciala, E., Kučera, J., Lindroth, A., and Hallgren, J. E. (1992). Radial velocity profiles of water flow in stems of spruce and oak and response of spruce tree to severing. *Tree Physiol.* 10, 367–380.
- Cermák, J., and Kučera, J. (1981). The compensation of natural temperature gradient at the measuring point during the sap flow rate determination in trees. *Biol. Plant.* 23, 409-477.

- Chamel, A., Pineri, M., and Escoubes, M. (1991). Quantitative determination of water sorption by plant cuticles. *Plant Cell Environ.* 14, 87–95.
- Chaney, W. R. (1981). Sources of water. In "Water Deficits and Plant Growth" (T. T. Kozlowski, ed.), Vol. 6, pp. 1-47. Academic Press, New York.
- Chang, T. T., Loresto, G. C., and Tagumpay, O. (1974). Screening rice germ plasm for drought resistance. SABRAO J. 6, 9-16.
- Chapman, A. G. (1935). The effects of black locust on associated species with special reference to forest trees. *Ecol. Monographs* 5, 37-60.
- Chapman, D. J. (1985). Geological factors and biochemical aspects of the origin of land plants. *In* "Geological Factors and the Evolution of Plants" (B. H. Tiffney, ed.), pp. 23-44. Yale University Press, New Haven, CT.
- Chason, J. W., Baldocchi, D. D., and Huston, M. A. (1991). A comparison of direct and indirect methods for estimating forest canopy leaf area. *Agric. For. Meteorol.* 57, 107-128.
- Chatfield, C., and Adams, G. (1940). Proximate composition of American food materials. U.S. Dept. Agric. Circ. 549.
- Cheeseman, J. M. (1991). PATCHY: Simulating and visualizing the effects of stomatal patchiness on photosynthetic CO₂ exchange studies. *Plant Cell Environ.* 14, 593-599.
- Chrispeels, M. J., and Maurel, C. (1994). Aquaporins: The molecular basis of facilitated water movement through living plant cells? *Plant Physiol.* 105, 9-13.
- Chung, H.-H., and Kramer, P. J. (1975). Absorption of water and ³²P through suberized and unsuberized roots of loblolly pine. *Can. J. For. Res.* 5, 229–235.
- Claassen, M. M., and Shaw, R. H. (1970). Water deficit effects on corn. II. Grain components. Agron. J. 62, 652-655.
- Clark, J., and Gibbs, R. D. (1957). Studies in tree physiology. IV. Further investigations of seasonal changes in moisture content of certain Canadian forest trees. Can. J. Bot. 35, 219–253.
- Clark, W. S. (1874). The circulation of sap in plants. Mass. State Board Agr. Annu. Rep. 21, 159–204.
- Clark, W. S. (1875). Observations upon the phenomena of plant life. Mass. State Board Agr. Annu. Rep. 22, 204-312.
- Clarke, J. M. (1986). Effect of leaf rolling on leaf water loss in Triticum spp. Can. J. Plant Sci. 66, 885-891.
- Clarkson, D. T. (1976). The influence of temperature on the exudation of xylem sap from detached root systems of Orye (Secale cereale) and barley (Hordeum vulgare). Planta 132, 297-304.
- Clarkson, D. T. (1985). Factors affecting mineral nutrient acquisition by plants. Annu. Rev. Plant Physiol. 36, 77-115.
- Clarkson, D. T. (1993). Roots and the delivery of solutes and water to the xylem. *Phil. Trans. Roy. Soc. London Ser. B* **341**, 5–17.
- Clarkson, D. T., Mercer, E. R., Johnson, M. G., and Mattam, D. (1975). The uptake of nitrogen (ammonium and nitrate) by different segments of the roots of intact barley plants. *Annu. Rep. Agric. Res. Counc.*, *Letcombe Lab*, pp. 10-13.
- Cleland, R. (1959). Effect of osmotic concentration on auxin-action and on irreversible and reversible expansion of the *Avena* coleoptile. *Physiol. Plant.* 12, 809–825.
- Cleland, R. E. (1971). Cell wall extension. Annu. Rev. Plant Physiol. 22, 197-222.
- Cleland, R. E. (1973). Auxin-induced hydrogen ion excretion from *Avena* coleoptiles. *Proc. Natl. Acad. Sci. USA* 70, 3092-3093.
- Cleland, R. E. (1975). Auxin-induced hydrogen ion excretion: correlation with growth, and control by external pH and water stress. *Planta* 127, 233-242.

- Cleland, R. E. (1977). The control of cell enlargement. Symp. Soc. Exp. Biol. 31, 101-115.
- Cleland, R. E. (1983). The capacity for acid-induced wall loosening as a factor in the control of *Avena* coleoptile cell elongation. *J. Exp. Bot.* 34, 676–680.
- Cleland, R. E. (1986). The role of hormones in wall loosening and plant growth. Aust. J. Plant Physiol. 13, 93-103.

- Cleland, R. E., and Rayle, D. L. (1978). Auxin, H+-excretion and cell elongation. Bot. Mag. Tokyo Spec. Issue 1, 125-139.
- Clements, F. E., and Long, F. L. (1934). The method of collection films for stomata. Am. J. Bot. 21, 7-17.
- Clements, H. F. (1934). Significance of transpiration. Plant Physiol. 9, 165-171.
- Close, T. J., and Bray, E. A., eds. (1993). "Plant Responses to Cellular Dehydration During Environmental Stress." American Society of Plant Physiologists Series, Rockville, Maryland.
- Close, T. J., and Chandler, P. M. (1990). Cereal dehydrins: Serology, gene mapping and potential functional roles. Aust. J. Plant Physiol. 17, 333-334.
- Close, T. J., Kortt, A. A., and Chandler, P. M. (1989). A cDNA-based comparison of dehydration-induced proteins (dehydrins) in barley and corn. Plant Mol. Biol. 13, 95-108.
- Cochard, H. (1992). Vulnerability of several conifers to air embolism. Tree Physiol. 11, 73-83.
- Cohen, Y., Fuchs, M., Falkenflug, V., and Moreshet, S. (1988). Calibrated heat pulse method for determining water uptake in cotton. Agron. J. 80, 398-402.
- Cohen, Y., Takeuchi, S., Nozaka, J., and Yano, T. (1993). Accuracy of sap flow measurement using heat balance and heat pulse methods. *Agron. I.* 85, 1080–1086.
- Coile, T. S. (1937). Distribution of forest tree roots in North Carolina Piedmont soils. J. For. 35, 247-257.
- Coile, T. S. (1940). Soil charges associated with loblolly pine succession on abandoned agricultural land of the Piedmont Plateau. Duke Univ. School of For. Bull. 5.
- Cole, F. D., and Decker, J. P. (1973). Relation of transpiration to atmospheric vapor pressure. J. Arizona Acad. Sci. 8, 74-75.
- Colire, C., LeRumeur, E., Gallier, J., deCertaines, J., and Larker, F. (1988). An assessment of proton nuclear magnetic resonance as an alternative method to describe water status of leaf tissue in wilted plants. *Plant Physiol. Biochem.* 26, 767–776.
- Collatz, G. J., Ball, J. T., Grivet, C., and Berry, J. A. (1991). Physiological and environmental regulation of stomatal conductance, photosynthesis and transpiration: A model that includes a laminar boundary layer. Agric. For. Meteorol. 54, 107–136.
- Collatz, G. J., Ribas-Carbo, M., and Berry, J. A. (1992). Coupled photosynthesis-stomatal conductance model for leaves of C₄ plants. Aust. J. Plant Physiol. 19, 519-538.
- Colombo, M. F., Rau, D. C., and Parsegian, V. A. (1992). Protein solvation in allosteric regulation: A water effect on hemoglobin. *Science* 256, 655-659.
- Colton, C. E., and Einhellig, F. E. (1980). Allelopathic mechanisms of velvet leaf (Abutilon theophrasti, Medic., Malvaceae) on soybean. Am. J. Bot. 67, 1407-1413.
- Condon, A. G., Farquhar, G. D., and Richards, R. A. (1990). Genotypic variation in carbon isotope discrimination and transpiration efficiency in wheat: Leaf gas exchange and whole plant studies. *Aust. J. Plant Physiol.* 17, 9–22.
- Condon, A. G., Richards, R. A., and Farquhar, G. D. (1987). Carbon isotope discrimination is positively correlated with grain yield and dry matter production in field-grown wheat. *Crop Sci.* 27, 996–1001.
- Constable, J. V. H., Grace, J. B., and Longstreth, D. J. (1992). High carbon dioxide concentrations in aerenchyma of Typha latifolia. Am. J. Bot. 79, 415-418.
- Cook, G. D., Dixon, J. R., and Leopold, A. C. (1964). Transpiration: Its effects on plant leaf temperature. Science 144, 546-547.
- Cope, F. W. (1967). NMR evidence for complexing of Na⁺ in muscle, kidney, and brain, and by actomyosin: The relation of cellular complexing of Na⁺ to water structure and to transport kinetics. J. Gen. Physiol. 50, 1353–1375.
- Corak, S. J., Blevins, D. G., and Pallardy, S. G. (1987). Water transfer in an alfalfa-maize association: Survival of maize during drought. *Plant Physiol.* 84, 582-586.
- Corey, A. T., and Klute, A. (1985). Application of the potential concept to soil water equilibrium and transport. Soil Sci. Soc. Am. J. 49, 3-11.
- Cornic, G., Le Gouallec, J.-L., Briantais, J. M., and Hodges, M. (1989). Effect of dehydration and

- high light on photosynthesis of two C₃ plants (*Phaseolus vulgaris* L. and *Elatostema repens* (Lour.) Hall f.). *Planta* 177, 84-90.
- Cortes, P. M. (1992). Analysis of the electrical coupling of root cells: Implications for ion transport and the existence of an osmotic pump. *Plant Cell Environ.* 15, 351–363.
- Cosgrove, D. J. (1985). Cell wall yield properties of growing tissue: Evaluation by in vivo stress relaxation. Plant Physiol. 78, 347-356.
- Cosgrove, D. J. (1987). Wall relaxation in growing stems: Comparison of four species and assessment of measurement techniques. *Planta* 171, 266-278.
- Cosgrove, D. J., and Cleland, R. E. (1983a). Solutes in the free space of growing stem tissues. *Plant Physiol.* 72, 326-331.
- Cosgrove, D. J., and Cleland, R. E. (1983b). Osmotic properties of pea internodes in relation to growth and auxin action. *Plant Physiol.* 72, 332-338.
- Cosgrove, D. J., and Steudle, E. (1981). Water relations of growing pea epicotyl segments. *Planta* 153, 343-350.
- Cosgrove, D. J., Van Volkenburgh, E., and Cleland, R. E. (1984). Stress relaxation of cell walls and the yield threshold for growth: Demonstration and measurement by micropressure probe and psychrometer techniques. *Planta* 162, 46-54.
- Couchat, Ph., and Lasceve, G. (1980). Tritiated water vapour exchange method for the evaluation of whole plant diffusion resistance. J. Exp. Bot. 31, 1217-1222.
- Couchat, Ph., Moutonnet, P., Honelle, M., and Picard, D. (1980). *In situ* study of corn seedling root and shoot growth by neutron radiography. *Agron. J.* 72, 321–324.
- Coutts, M. P. (1983). Root architecture and tree stability. Plant Soil 71, 171-188.
- Cowan, I. R. (1965). Transport of water in the soil-plant-atmosphere system. J. Appl. Ecol. 2, 221-239.
- Cowan, I. R. (1972). Oscillations in stomatal conductance and plant functioning associated with stomatal conductance. J. Observations and a model. *Planta* (Berl.) 106, 185-219.
- Cowan, I. R. (1977). Stomatal behavior and environment. In "Advances in Botanical Research" (R. D. Preston and H. W. Woolhouse, eds.), Vol. 4, pp. 117-228. Academic Press, New York.
- Cowan, I. R. (1982). Regulation of water use in relation to carbon gain in higher plants. *In* "Encyclopedia of Plant Physiology" (O. L. Lange and J. D. Bewley, eds.), Vol. 12B, pp. 535-562. Springer-Verlag, Berlin.

- Crafts, A. S. (1936). Further studies on exudation in cucurbits. Plant Physiol. 11, 63-79.
- Crafts, A. S., and Broyer, T. C. (1938). Migration of salts and water into xylem of the roots of higher plants. Am. J. Bot. 25, 529-535.
- Crafts, A. S., Currier, H. B., and Stocking, C. R. (1949). "Water in the Physiology of the Plant." Chronica Botanica Co., Waltham, MA.
- Cramer, G. R., and Bowman, D. C. (1991). Short-term leaf elongation kinetics in response to salinity are independent of the root. *Plant Physiol.* 95, 965–967.
- Crawford, N. M., and Campbell, W. H. (1990). Fertile fields. Plant Cell 2, 829-835.
- Crawford, R. M. M. (1976). Tolerance of anoxia and the regulation of glycolysis in tree roots. *In* "Tree Physiology and Yield Improvement" (M. G. R. Cannell and F. T. Last, eds.), pp. 387–401. Academic Press, New York.
- Creelman, R. A., Mason, H. S., Bensen, R. J., Boyer, J. S., and Mullet, J. E. (1990). Water deficit and abscisic acid cause differential inhibition of shoot *versus* root growth in soybean seedlings. *Plant Physiol.* 92, 205–214.
- Criswell, J. G., Havelka, U. D., Quebedeaux, B., and Hardy, R. W. F. (1976). Adaptation of nitrogen fixation by intact soybean nodules to altered rhizosphere pO₂. *Plant Physiol.* 16, 131–140.
- Crook, M. J., and Ennos, A. R. (1993). The mechanics of root lodging in winter wheat, *Triticum aestivum* L. J. Exp. Bot. 44, 1219-1224.
- Crowe, J. H., and Crowe, L. M. (1986). Stabilization of membranes in anhydrobiotic organisms. *In* "Membranes, Metabolism and Dry Organisms" (A. C. Leopold, ed.), pp. 188–209. Comstock

- Publishing Association, Ithaca, NY.
- Crowe, J. H., Crowe, L. M., Carpenter, J. F., Rudolph, A. S., Wistrom, C. A., Spargo, B. J., and Anchordoguy, T. J. (1988). Interactions of sugars with membranes. *Biochim. Biophys. Acta* 947, 367–384.
- Crowe, J. H., Spargo, B. J., and Crowe, L. M. (1987). Preservation of dry liposomes does not require retention of residual water. *Proc. Natl. Acad. Sci. USA* 84, 1537-1540.
- Crowe, L. M., Mouradian, R., Crowe, J. H., Jackson, S. A., and Womersley, C. (1984). Effects of carbohydrates on membrane stability at low water activities. *Biochim. Biophys. Acta* 769, 141–150.
- Crowe, L. M., Womersley, C., Crowe, J. H., Reid, D., Appel, L., and Rudolph, A. (1986). Prevention of fusion and leakage in freeze-dried liposomes by carbohydrates. *Biochim. Biophys. Acta* 861, 131-140.
- Cruz, R. T., Jordan, W. R., and Drew, M. C. (1992). Structural changes and associated reduction of hydraulic conductance in roots of *Sorghum bicolor* L. following exposure to water deficits. *Plant Physiol.* 99, 203–212.
- Cumming, J. R., and Weinstein, L. H. (1990). Aluminum-mycorrhizal interactions in the physiology of pitch pine seedlings. *Plant Soil* 125, 7-18.
- Curl, E. A., and Truelove, B. (1986). "The Rhizosphere." Springer-Verlag, Berlin.
- Currie, D. J., and Paquin, V. (1987). Large-scale biogeographical patterns of species richness of trees. Nature (London) 329, 326-327.
- Curtis, L. C. (1944). The exudation of glutamine from lawn grass. Plant Physiol. 19, 1-5.
- Curtis, O. F. (1936). Leaf temperatures and the cooling of leaves by radiation. *Plant Physiol.* 11, 343-364.
- Cutler, J. M., and Rains, D. W. (1977a). Effects of water stress and hardening on the internal water relations and osmotic constituents of cotton leaves. *Physiol. Plant.* 42, 261–268.
- Cutler, J. M., and Rains, D. W. (1977b). Effect of irrigation history on responses of cotton to subsequent water stress. *Crop Sci.* 17, 329-335.
- Cutler, J. M., Rains, D. W., and Loomis, R. S. (1977). Role of changes in solute concentration in maintaining favorable water balance in field-grown cotton. *Agron. J.* 69, 773–779.
- Cutler, J. M., Shannon, K. W., and Steponkus, P. L. (1980a). Influence of water deficits and osmotic adjustment on leaf elongation in rice. *Crop Sci.* 20, 314-318.
- Cutler, J. M., Steponkus, P. L., Wach, M. J., and Shahan, K. W. (1980b). Dynamic aspects and enhancement of leaf elongation in rice. *Plant Physiol.* 66, 147–152.
- Dacey, J. W. H. (1981). Pressurized ventilation in the yellow water lily. *Ecology* 62, 1137–1147.
- Dacey, J. W. H. (1987). Krudsen-transitional flow and gas pressurization in leaves of Nelumbo. Plant Physiol. 85, 199-203.
- Dainty, J. (1963). Water relations of plant cells. Adv. Bot. Res. 1, 279-326.
- Dainty, J., and Ginzburg, B. Z. (1964). The reflection coefficient of plant cell membranes for certain solutes. Biochim. Biophys. Acta 79, 129-137.
- Dakora, F. D., and Atkins, C. A. (1989). Diffusion of oxygen in relation to structure and function in legume root nodules. Aust. J. Plant Physiol. 16, 131-140.
- Daley, P. F., Raschke, K., Ball, J. T., and Berry, J. A. (1989). Topography of photosynthetic activity of leaves obtained from video images of chlorophyll fluorescence. *Plant Physiol.* 90, 1233– 1238.
- Dalton, F. N. (1988). Plant root water extraction studies using stable isotopes. Plant Soil 111, 217-221.
- Dalton, F. N., Raats, P. A. C., and Gardner, W. R. (1975). Simultaneous uptake of water and solutes by plant roots. *Agron. J.* 67, 334-339.
- Damptey, H. B., Coombe, B. G., and Aspinall, D. (1978). Apical dominance, water deficit, and axillary inflorescence growth in *Zea Mays:* The role of abscisic acid. *Ann. Bot.* (London) 42, 1447–1458.
- Daniels, B. A., Hetrick, D., Gerschefske, K., and Wilson, G. T. (1987). Effects of drought stress on

- growth response in corn, sudan grass, and big bluestem to Glomus etunicatum. New Phytol. 105, 403-410.
- Darwin, C. (1880). "The Power of Movement in Plants." Murray, London.
- Darwin, C. (1881). "The Formation of Vegetable Mould through the Action of Worms." Murray, London.
- Darwin, F., and Pertz, D. F. M. (1911). On a new method of estimating the aperture of stomata. Proc. Roy. Soc. (London) B84, 136-154.
- Dasberg, S., and Dalton, F. N. (1985). Time domain reflectometry field measurements of soil water content and electrical conductivity. Soil Sci. Soc. Am. J. 49, 293–297.
- Dasgupta, J., and Bewley, J. D. (1984). Variations in protein synthesis in different regions of greening leaves of barley seedlings and effects of imposed water stress. J. Exp. Bot. 35, 1450-1459.
- Daughters, M. R., and Glenn, D. S. (1946). The role of water in freezing foods. Refrig. Engin. 52, 137-148.
- Daum, C. R. (1967). A method for determining water transport in trees. Ecology 48, 425-431.
- Davey, A. G., and Simpson, R. J. (1990). Nitrogen fixation by subterranean clover at varying stages of nodule dehydration. J. Carbohydrate status and short-term recovery of nodulated root respiration. J. Exp. Bot. 41, 1175-1187.
- Davidson, O. W. (1945). Salts in old greenhouse soils stunt flowers and vegetables. *Florists Rev.* 95, 17–19.
- Davies, W. J. (1977). Stomatal responses to water stress and light in plants grown in controlled environments and in the field. *Crop Sci.* 17, 735-740.
- Davies, W. J. (1986). Transpiration and the water balance of plants. *In* "Plant Physiology" (F. C. Stewart, J. F. Sutcliffe and J. E. Dale, eds.), Vol. IX, pp. 49–154. Academic Press, Orlando, FL.
- Davies, W. J., Kozlowski, T. T., and Pereira, J. (1974). Effects of wind on transpiration and stomatal aperture of woody plants. *Bull. Roy. Soc. N.Z.* 12, 433-438.
- Davies, W. J., Mansfield, T. A., and Hetherington, A. M. (1990). Sensing of soil water status and the regulation of plant growth and development. *Plant Cell Environ.* 13, 709-719.
- Davies, W. J., Metcalfe, J., Lodge, T. A., and DaCosta, A. R. (1986). Plant growth substances and the regulation of growth under drought. *Aust. J. Plant Physiol.* 13, 105-125.
- Davies, W. J., Tardieu, F., and Trejo, C. L. (1994). How do chemical signals work in plants that grow in drying soil? *Plant Physiol.* 104, 309-314.
- Davies, W. J., and Van Volkenburgh, E. (1983). The influence of water deficit on the factors controlling the daily pattern of growth of *Phaseolus* trifoliates. J. Exp. Bot. 34, 987-999.
- Davies, W. J., and Zhang, J. (1991). Root signals and the regulation of growth and development of plants in drying soil. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 42, 55-76.
- Davis, R. E., Rosseau, D. L., and Board, R. D. (1971). "Polywater": Evidence from electron spectroscopy for chemical analysis (ESCA) of a complex salt matrix. Science 171, 167-171.
- Dawson, R. F. (1942). Accumulation of nicotine in reciprocal grafts of tomato and tobacco. Am. J. Bot. 29, 66-71.
- Dawson, T. E. (1993). Hydraulic lift and water use by plants: Implications for water balance, performance and plant-plant interactions. Oecologia 95, 565-574.
- Day, T. A., Heckathorn, S. A., and DeLucia, F. H. (1991). Limitations of photosynthesis in *Pinus taeda* L. (loblolly pine) at low soil temperatures. *Plant Physiol.* 96, 1246-1254.
- de Candolle, A. P. (1832). "Physiologie Végétale." Bechet Jeune, Paris.
- de Saussure, N. T. (1804). "Recherches Chimiques sur la Végétation." Madame Huzard, Paris.
- de Vries, H. (1877). "Untersuchungen über die mechanische Ursachen der Zellstreckung." W. Engelmann, Leipzig.
- de Wit, C. T. (1958). Transpiration and crop yields. *In* "Institute of Biological and Chemical Research on Field Crops and Herbage," Wageningen, The Netherlands, Verslagen Landbouwkundige Onderzoekingen 64.6, 1–88.
- Decker, J. P., Gaylor, W. G., and Cole, F. D. (1962). Measuring transpiration of undisturbed tamarisk shrubs. *Plant Physiol.* 37, 393-397.

- Decker, J. P., and Skau, C. M. (1964). Simultaneous studies of transpiration rate and sap velocity in trees. *Plant Physiol.* 39, 213-215.
- Delhaize, E., Ryan, P. R., and Randall, P. J. (1993). Aluminum tolerance in wheat (*Triticum aestivum* L.). II. Aluminum-stimulated excretion of malic acid from root apices. *Plant Physiol.* 103, 695-702.
- DeLucia, E. H. (1986). Effect of low-root temperature on net photosynthesis, stomatal conductance and carbohydrate concentration in Engelmann spruce (*Picea engelmannii* Parry ex Engelm.) seedlings. *Tree Physiol.* 2, 143–154.
- Delves, A. C., Higgins, A. V., and Greenough, P. M. (1987). Shoot control of supernodulation in a number of mutant soybeans, Glycine max (L.) Merr. Aust. J. Plant Physiol. 14, 689-694.
- Denison, R. F., Hunt, S., and Layzell, D. B. (1992). Nitrogenase activity, nodule respiration and O₂ permeability following detopping of alfalfa and birdsfoot trefoil. *Plant Physiol.* 98, 894-900.
- Denison, R. F., Smith, D. L., Legros, T., and Layzell, D. B. (1991). Noninvasive measurement of internal oxygen concentration of field-grown soybean nodules. *Agron. J.* 83, 166-169.
- Denmead, O. T., and Shaw, R. H. (1962). Availability of soil water to plants as affected by soil moisture content and meteorological conditions. *Agron. J.* 54, 385-390.
- Desai, M. C. (1937). Effect of certain nutrient deficiencies on stomatal behavior. *Plant Physiol.* 12, 253-283.
- DeWald, D. B., Mason, H. S., and Mullet, J. E. (1992). The soybean vegetative storage proteins $VSP\alpha$ and $VSP\beta$ are acid phosphatases active on polyphosphates. J. Biol. Chem. 267, 15958–15964.
- Dexter, A. R. (1987). Mechanics of root growth. Plant Soil 98, 303-312.
- Dhindsa, R. S., and Bewley, J. D. (1976). Plant desiccation: Polysome loss not due to ribonuclease. *Science* 191, 181-182.
- Dhindsa, R. S., and Bewley, J. D. (1978). Messenger RNA is conserved during drying of the drought-tolerant moss *Tortula ruralis*. *Proc. Natl. Acad. Sci. USA* 75, 842-846.
- Dimond, A. F. (1966). Pressure and flow relations in vascular bundles of the tomato plant. *Plant Physiol.* 41, 119–131.
- Dittmer, H. J. (1937). A quantitative study of the roots and root hairs of a winter rye plant (Secale cereale). Am. J. Bot. 24, 417-420.
- Dixon, H. H., and Joly, J. (1895). The path of the transpiration current. Ann. Bot. (London) 9, 416-419.
- Dixon, M. A., Grace, J., and Tyree, M. T. (1984). Concurrent measurements of stem density, leaf and stem water potential, stomatal conductance, and cavitation on a sapling of *Thuja occidentalis* L. *Plant Cell Environ.* 7, 615-618.
- Dixon, R. K., Pallardy, S. G., Garrett, H. E., and Cox, G. S. (1983). Comparative water relations of container-grown and bare root-grown ectomycorrhizal and nonmycorrhizal Quercus velutina seedlings. Can. J. Bot. 61, 1559-1565.
- Döbereiner, J. (1983). Dinitrogen fixation in rhizosphere and phyllosphere associations. *In* "Encyclopedia of Plant Physiology" (A. Läuchli and R. L. Bieleski, eds.), Vol. 15A, pp. 330–350. Springer-Verlag, Berlin/Heidelberg.
- Dong, Z., Canny, M. J., McCully, M. E., Roboredo, M. R., Cabadilla, C. F., Ortega, E., and Rodés, R. (1994). A nitrogen-fixing endophyte of sugarcane stems. *Plant Physiol.* 105, 1139–1147.
- Downton, W. J. S., Loveys, B. R., and Grant, W. J. R. (1988a). Stomatal closure fully accounts for the inhibition of photosynthesis by abscisic acid. *New Phytol.* 108, 263-266.
- Downton, W. J. S., Loveys, B. R., and Grant, W. J. R. (1988b). Non-uniform stomatal closure induced by water stress causes putative non-stomatal inhibition of photosynthesis. *New Phytol.* 110, 503-509.
- Drew, M. C., Chamel, A., Garrec, J.-P., and Fourcy, A. (1980). Cortical air spaces (aerenchyma) in roots of corn subjected to oxygen stress: Structure and influence on uptake and translocation of ⁸⁶rubidium ions. *Plant Physiol.* 65, 506-511.
- Drew, M. C., Jackson, M. B., and Giffard, S. (1979a). Ethylene-promoted adventitious rooting and

- development of cortical air spaces (aerenchyma) in roots may be adaptive responses to flooding in Zea mays L. Planta 147, 83-88.
- Drew, M. C., Siswaro, E. J., and Saker, L. R. (1979b). Alleviation of waterlogging damage to young barley plants by application of nitrate and a synthetic cytokinin, and comparison between the effects of waterlogging, nitrogen deficiency and root excision. *New Phytol.* 82, 315–329.
- Drost-Hansen, W. (1965). Forms of water in biologic systems. Ann. N. Y. Acad. Sci. 125, 249-272. Drost-Hansen, W., and Clegg, J. S., eds. (1979). Cell-Associated Water." Academic Press, New York.
- Dudal, R. (1976). Inventory of the major soils of the world with special reference to mineral stress hazards. In "Plant Adaptation to Mineral Stress in Problem Soils" (M. J. Wright, ed.), pp. 3-14. Cornell University Agricultural Experiment Station, Ithaca, NY.
- Duddridge, J. A., Malibari, A., and Read, D. J. (1980). Structure and function of mycorrhizal rhizomorphs with special reference to their role in water transport. *Nature* 287, 834-836.
- Duell, R. W., and Markus, D. K. (1977). Guttation deposits on turfgrass. Agron. J. 69, 891-894. Dugas, W. A., Wallace, J. S., Allen, S. J., and Roberts, J. M. (1993). Heat balance porometer, and
- deuterium estimates of transpiration from potted trees. Agric. For. Meteorol. 64, 47–62.
- Duke, S. H., Schrader, L. E., Henson, C. A., Servaites, J. C., Vogelzang, R. D., and Pendleton, J. W. (1979). Low root temperature effects on soybean nitrogen metabolism and photosynthesis. *Plant Physiol.* 63, 956-962.
- Dumbroff, E. B., and Peirson, D. R. (1971). Probable sites for passive movement of ions across the endodermis. *Can. J. Bot.* 49, 35–38.
- Dunham, R. J., and Nye, P. H. (1973). I. Soil water content gradients near a plane of onion roots. J. Appl. Ecol. 10, 585-598.
- Duniway, J. M. (1977). Changes in resistance to water transport in safflower during the development of *Phytophthora* root rot. *Phytopath*. 67, 331-337.
- Durbin, R. D. (1967). Obligate parasites: Effect on the movement of solutes and water. In "The Dynamic Role of Molecular Constituents in Plant-Parasite Reactions" (C. J. Mirocha and I. Uritani, eds.), pp. 80-99. Am. Phytopath. Soc., St. Paul, MN.
- Dure, L., III, Crouch, M., Harada, J., Ho, T.-H. D., Mundy, J., Quatrano, R., Thomas, T., and Sung, Z. R. (1989). Common amino acid sequence domains among the LEA proteins of higher plants. *Plant Mol. Biol.* 12, 475–486.
- Dutrochet, H. J. (1837). "Memoires Pour Servir a l'Histoire Anatomique et Physiologie des Végétaux et des Animaux." J. B. Baillière et Fils, Paris.
- Duvdevani, S. (1953). Dew gradients in relation to climate, soil and topography. Desert Res. Proc. Int. Symp. 1952 Spec. Publ. 2, 136-152.
- Dye, P. J., and Olbrich, B. W. (1993). Estimating transpiration from 6-year-old *Eucalyptus grandis*: Development of a canopy conductance model and comparison with independent sap flow measurements. *Plant Cell Environ.* 16, 45-53.
- Dye, P. J., Olbrich, B. W., and Calder, I. R. (1992). A comparison of the heat pulse method and deuterium tracing method for measuring transpiration from *Eucalyptus grandis* trees. J. Exp. Bot. 43, 337-343.
- Eames, A. J., and MacDaniels, L. H. (1947). "An Introduction to Plant Anatomy," 2nd Ed. McGraw-Hill, New York.
- Eaton, F. M. (1927). The water requirement and cell-sap concentration of Australian saltbush and wheat as related to the salinity of the soil. Am. I. Bot. 14, 212-226.
- Faton, F. M. (1930). Cel-sap concentration and transpiration as related to age and development of cotton leaves. J. Agr. Res. 40, 791-805.
- Eaton, F. M. (1931). Root development as related to character of growth and fruitfulness of the cotton plant. J. Agr. Res. 43, 875-883.
- Eaton, F. M. (1942). Toxicity and accumulation of chloride and sulfate salts in plants. J. Agr. Res. 64, 357-399.

- Eaton, F. M., and Harding, R. B. (1959). Foliar uptake of salt constituents of water by citrus plants during intermittent sprinkling and immersion. *Plant Physiol.* 34, 22-26.
- Eavis, B. W., and Taylor, H. M. (1979). Transpiration of soybeans as related to leaf area, root length, and soil water content. Agron. J. 71, 441-445.
- Eck, H. V., and Musick, J. T. (1979). Plant water stress effects on irrigated grain sorghum. II. Effects on nutrients in plant tissues. *Crop Sci.* 19, 592-598.
- Edlefsen, N. F., and Bodman, G. B. (1941). Field measurements of water movement through a silt loam soil. Am. Soc. Agron. J. 33, 713-731.
- Edmeades, G. O., Bolaños, J., Hernández, M., and Bello, S. (1993). Causes for silk delay in a low-land tropical maize population. Crop Sci. 33, 1029-1035.
- Edmeades, G. O., Bolaños, J., and Lafitte, H. R. (1992). Progress in breeding for drought tolerance in maize. *In* "Proceedings of the Forty-Seventh Annual Corn and Sorghum Industry Research Conference," pp. 93-111.
- Edsall, J. T., and McKenzie, H. A. (1978). Water and proteins. I. The significance and structure of water: Its interaction with electrolytes and non-electrolytes. Adv. Biophys. 10, 137-207.
- Ehleringer, J. R., and Cook, C. S. (1984). Photosynthesis in *Encelia farinosa* Gray in response to decreasing leaf water potential. *Plant Physiol.* 75, 688-693.
- Ehleringer, J. R., and Field, C. B. (1993). "Scaling Physiological Processes." Academic Press, San Diego.
- Ehleringer, J. R., Hall, A. E., and Farquhar, G. D., eds. (1993). "Stable Isotopes and Plant Carbon-Water Relations." Academic Press, San Diego.
- Ehlig, C. F. (1962). Measurement of energy status of water in plants with a thermocouple psychrometer. *Plant Physiol.* 37, 288-290.
- Ehret, D. L., and Boyer, J. S. (1979). Potassium loss from stomatal guard cells at low water potentials. J. Exp. Bot. 30, 225-234.
- Eisenberg, D., and Kauzmann, W. (1969). "The Structure and Properties of Water." Oxford University Press, New York.
- Ekanayake, I. J., O'Toole, J. C., Garrity, D. P., and Masajo, T. M. (1985). Inheritance of root characters and their relations to drought resistance in rice. *Crop Sci.* 25, 927-933.
- Ekern, P. C. (1965). Evapotranspiration of pineapple in Hawaii. Plant Physiol. 40, 736-739.
- El Nadi, A. H., Brouwer, R., and Locker, J. Th. (1969). Some responses of the root and the shoot of *Vicia faba* plants to water stress. *Neth. J. Agric. Sci.* 17, 133-142.
- Elfving, F. (1882). Ueber die Wasserleitung im Holz. Bot. Zeitung 42, 706-723.
- Emerson, W. W., Bond, R. D., and Dexter, A. R., eds. (1978). "Modification of Soil Structure." Wiley, New York.
- England, C. B., and Lesesne, E. H. (1962). Evapotranspiration research in western North Carolina. *Agr. Eng.* 43, 526-528.
- Ennos, A. R., Crook, M. J., and Grimshaw, C. (1993). The anchorage mechanics of maize, Zea mays. J. Exp. Bot. 44, 147-153.
- Epstein, A. H. (1978). Root graft transmission of tree pathogens. Annu. Rev. Phytopathol. 16, 181-192.
- Epstein, E. E. (1972). "Mineral Nutrition of Plants: Principles and Perspectives." Wiley, New York. Errera, L. (1886). Ein Transpirationsversuch. Ber. deut. bot. Ges. 4, 16–18.
- Esau, K. (1965). "Plant Anatomy," 2nd Ed. Wiley, New York.
- Evans, H. J., and Sorger, G. J. (1966). Role of mineral elements with emphasis on the univalent cations. *Annu. Rev. Plant Physiol.* 17, 47-76.
- Evans, H. J., and Wildes, R. A. (1971). Potassium and its role in enzyme activation. *In* "Potassium in Biochemistry and Physiology," pp. 13–38. International Potash Institute, Bern, Switzerland.
- Evans, P. S., and Klett, J. E. (1985). The effects of dormant branch thinning on total leaf, shoot, and root production from bare-root *Prunus cerasifera* "Newportii." *J. Arboric.* 11, 149–151.
- Everard, J. D., and Drew, M. C. (1989). Mechanisms controlling changes in water movement

- through the roots of *Helianthus annuus* L. during continuous exposure to oxygen deficiency. *J. Exp. Bot.* 40, 95-104.
- Faiz, S. M. A., and Weatherley, P. E. (1978). Further investigations into the location and magnitude of the hydraulic resistances in the soil-plant system. *New Phytol.* 81, 19–28.
- Faiz, S. M. A., and Weatherley, P. E. (1982). Root contraction in transpiring plants. *New Phytol.* 92, 333-343.
- Falk, M., and Kell, G. S. (1966). Thermal properties of water: Discontinuities questioned. Science 154, 1013-1015.
- Faroud, N., Lynch, D. R., and Entz, T. (1993). Potato water content impact on soil moisture measurement by neutron meter. *Plant Soil* 148, 101-106.
- Farquhar, G. D., and Sharkey, T. D. (1982). Stomatal conductance and photosynthesis.. Annu. Rev. Plant Physiol. 33, 317-345.
- Farquhar, G. D., Wetselaar, R., and Firth, P. M. (1979). Ammonia volatilization from senescing leaves of maize. *Science* 203, 1257-1258.
- Farris, F., and Strain, B. R. (1978). The effects of water stress on leaf H₂¹⁸O enrichment. Rad. Environ. Biophys. 15, 167-202.
- Fayle, D. C. F. (1978). Poor vertical root development may contribute to suppression in a red pine plantation. For. Chron. 54, 99-103.
- Feldman, L. J. (1984). Regulation of root development. Annu. Rev. Plant Physiol. 35, 223-242.
- Fellows, R. J., and Boyer, J. S. (1976). Structure and activity of chloroplasts of sunflower leaves having various water potentials. *Planta* 132, 229-239.
- Fellows, R. J., and Boyer, J. S. (1978). Altered ultrastructure of cells of sunflower leaves having low water potentials. *Protoplasma* 93, 381-395.
- Fellows, R. J., Patterson, R. P., Raper, C. D., and Harris, D. (1987). Nodule activity and allocation of photosynthate of soybean during recovery from water stress. *Plant Physiol.* 84, 456-460.
- Fensom, D. S. (1957). The bioelectric potentials of plants and their functional significance. Can. J. Bot. 35, 573-582.
- Fensom, D. S. (1958). The bioelectric potentials of plants and their functional significance. II. The patterns of bioelectric potential and exudation rate in excised sunflower roots and stems. Can. J. Bot. 36, 367-383.
- Fereres, E., Kiflas, P. M., Goldfein, R. E., Pruitt, W. O., and Hagan, R. M. (1981). Simplified but scientific irrigation scheduling. *Calif. Agric.* 36, 19–21.
- Ferguson, H., and Gardner, W. H. (1962). Water content measurement in soil columns by gamma ray absorption. Soil Sci. Soc. Am. Proc. 26, 11-14.
- Fick, A. (1855). Über Diffusion. Poggendorffs Annalen 94, 59–86.
- Fischer, A. G. (1982). Long-term climatic oscillations recorded in stratigraphy. *In* "Climate in Earth History" (W. H. Berger and J. C. Crowell, eds.), pp. 97–104. Studies in Geophysics, Natl. Acad. Press, Washington, DC.
- Fischer, A. G. (1984). The two phanerozoic supercycles. *In* "Catastrophes and Earth History" (W. A. Berggren and J. A. van Couvering, eds.), pp. 129-150. Princeton University Press, Princeton, NJ.
- Fischer, D. B., and Frame, J. M. (1984). A guide to the use of the exuding-stylet technique in phloem physiology. *Planta* 161, 385–393.
- Fischer, R. A. (1968a). Stomatal opening in isolated epidermal strips of *Vicia faba*. I. Response to light and to CO₂-free air. *Plant Physiol.* 43, 1947–1952.
- Fischer, R. A. (1968b). Stomatal opening: Role of potassium uptake by guard cells. *Science* 168, 784-785.
- Fischer, R. A. (1970). After-effect of water stress on stomatal opening potential. II. Possible causes. *J. Exp. Bot.* 21, 386-404.
- Fischer, R. A. (1971). Role of potassium in stomatal opening in the leaf of *Vicia faba*. *Plant Physiol.* 47, 555-558.

- Fischer, R. A., and Hsiao, T. C. (1968). Stomatal opening in isolated epidermal strips of *Vicia faba*. II. Responses to KCl concentration and the role of potassium absorption. *Plant Physiol.* 43, 1953–1958.
- Fiscus, E. L. (1975). The interaction between osmotic- and pressure-induced water flow in plant roots. *Plant Physiol.* 55, 917–922.
- Fiscus, E. L. (1977). Determination of hydraulic and osmotic properties of soybean root systems. *Plant Physiol.* **59**, 1013–1020.
- Fiscus, E. L. (1981). Analysis of the components of area growth of bean root systems. *Crop Sci.* 21, 909–913.
- Fiscus, E. L. (1986). Diurnal changes in volume and solute transport coefficients of *Phaseolus* roots. *Plant Physiol.* 80, 752-759.
- Fiscus, E. L., and Kramer, P. J. (1970). Radial movement of oxygen in plant roots. *Plant Physiol.* 45, 667-669.
- Fiscus, E. L., and Kramer, P. J. (1975). General model for osmotic and pressure-induced flow in plant roots. *Proc. Natl. Acad. Sci. USA* 72, 3114-3118.
- Fiscus, E. L., Klute, A., and Kaufmann, M. R. (1983). An interpretation of some whole plant water transport phenomena. *Plant Physiol.* 71, 810-817.
- Fiscus, E. L., Mahbub-Ul Alam, A. N. M., and Hirasawa, T. (1991). Fractional integrated stomatal opening to control water stress in the field. *Crop Sci.* 31, 1001–1008.
- Fiscus, E. L., and Markhart, A. H., III (1979). Relationships between root system water transport properties and plant size in *Phaseolus. Plant Physiol.* **64**, 770-773.
- Fiscus, E. L., Parsons, L. R., and Alberte, R. S. (1973). Phyllotaxy and water relations in tobacco. *Planta* 112, 285-292.
- Fiscus, E. L., Wullschleger, S. D., and Duke, H. R. (1984). Integrated stomatal opening as an indicator of water stress in Zea. Crop Sci. 24, 245-249.
- Fitter, A. H. (1987). An architectural approach to the comparative ecology of plant root systems. New Phytol. 106(Suppl.), 61-77.
- Flanagan, L. B., Comstock, J. P., and Ehleringer, J. R. (1991). Comparison of modeled and observed environmental influence on the stable oxygen and hydrogen isotope composition of leaf water in *Phaseolus vulgaris* L. *Plant Physiol.* 96, 588-596.
- Flanagan, L. B., Ehleringer, J. R., and Marshall, J. D. (1992). Differential uptake of summer precipitation among co-occurring trees and shrubs in a pinyon-juniper woodland. *Plant Cell Environ.* 15, 831-836.
- Flores, H. E., Dai, Y.-R., Cuello, J. L., Maldonado-Mendoza, I. E., and Loyola-Vargas, V. M. (1993). Green roots: Photosynthesis and photoautotrophy in an underground plant organ. *Plant Physiol.* 101, 363-371.
- Flowers, T. J., and Hanson, J. B. (1969). The effect of reduced leaf water potential on soybean mitochondria. *Plant Physiol.* 44, 939-945.
- Flowers, T. J., Troke, P. F., and Yeo, A. R. (1977). The mechanism of salt tolerance in halophytes. Annu. Rev. Plant Physiol. 28, 89-121.
- Fonteyn, P. J., Schlesinger, W. H., and Marion, G. M. (1987). Accuracy of soil thermocouple hygrometer measurements in desert ecosystems. *Ecology* 68, 1121–1124.
- Forseth, I. N., and Ehleringer, J. R. (1983). Ecophysiology of two solar tracking desert winter annuals. III. Gas exchange responses to light, CO₂ and VPD in relation to long-term drought. *Oecologia* 57, 344–351.
- Foster, R. G. (1981). The ultrastructure and histochemistry of the rhizosphere. New Phytol. 89, 263-273.
- Fowler, D., Cope, J. N., Deans, J. D., Leith, I. D., Murray, M. B., Smith, R. I., Sheppard, L. J., and Unsworth, M. H. (1989). Effects of acid mist on the frost hardiness of red spruce seedlings. New Phytol. 113, 321-335.
- Foyer, C. H. (1984). "Photosynthesis." Wiley, New York.

- Franco, C. M., and Magalhaes, A. C. (1965). Techniques for the measurement of transpiration of individual plants. *Arid Zone Res.* 25, 211–224, UNESCO, Paris.
- Franks, F., ed. (1975). "Water: A Comprehensive Treatise," Vol. 5. Plenum Press, New York...
- Franks, F. (1981). A scientific gold rush. Science 213, 1104-1105.
- Fraser, D. A., and Mawson, C. A. (1953). Movement of radioactive isotopes in yellow birch and white pine as detected with a portable scintillation counter. Can. J. Bot. 31, 324-333.
- Fraser, T. E., Silk, W. K., and Rost, T. L. (1990). Effects of low water potential on cortical cell length in growing regions of maize roots. *Plant Physiol.* 93, 648-651.
- Frederick, J. R., Woolley, J. T., Hesketh, J. D., and Peters, D. B. (1990). Water deficit development in old and new soybean cultivars. *Agron. J.* 82, 76–81.
- Freeman, T. P., and Duysen, M. E. (1975). The effect of imposed water stress on the development and ultrastructure of wheat chloroplasts. *Protoplasma* 83, 131-145.
- Frensch, J., and Hsiao, T. C. (1993). Hydraulic propagation of pressure along immature and mature xylem vessels of roots of *Zea mays* measured by pressure-probe techniques. *Planta* 190, 263-270.
- Frensch, J., and Steudle, E. (1989). Axial and radial hydraulic resistance to roots of maize (Zea mays L.). Plant Physiol. 91, 719-726.
- Frey-Wyssling, A. (1976). The plant cell wall. *In* "Handbuch der Pflanzenanatomie" (M. Zimmermann, S. Carlquist, and H. D. Wulff, eds.), Vol. 4. Gebrüder Borntraeger, Berlin.
- Friesner, R. C. (1940). An observation on the effectiveness of root pressure in the ascent of sap. Butler Univ. Bot. Studies 4, 226-227.
- Fritschen, L. J., Cox, L., and Kinerson, R. (1973). A 28-meter Douglas fir in a weighing lysimeter. For. Sci. 19, 256-261.
- Fritts, H. C. (1976). "Tree Rings and Climate." Academic Press, New York/London.
- Fromm, J., and Eschrich, W. (1993). Electric signals released from roots of willow (Salix viminalis L.) change transpiration and photosynthesis. J. Plant Physiol. 141, 673-680.
- Fromm, J., and Spanswick, R. (1993). Characteristics of action potentials in willow (Salix viminalis L.). J. Exp. Bot. 44, 1119-1125.
- Fry, K. E., and Walker, R. B. (1967). A pressure-infiltration method for estimating stomatal opening in conifers. *Ecology* 48, 155-157.
- Fry, S. C. (1989a). The structure and functions of xyloglucan. J. Exp. Bot. 40, 1-11.
- Fry, S. C. (1989b). Cellulases, hemicelluloses and auxin-stimulated growth: A possible relationship. *Physiol. Plant.* 75, 532-536.
- Furr, J. R., and Reeve, J. O. (1945). The range of soil-moisture percentages through which plants undergo permanent wilting in some soils from semiarid irrigated areas. J. Agric. Res. 71, 149-170.
- Furr, J. R., and Taylor, C. A. (1933). The cross-transfer of water in mature lemon trees. *Proc. Am. Soc. Hort. Sci.* 30, 45-51.
- Fusseder, A. (1983). A method for measuring length, spatial distribution and distance of living roots in situ. Plant Soil 73, 441-445.
- Gaastra, P. (1959). Photosynthesis of crop plants as influenced by light, carbon dioxide, temperature, and stomatal diffusion resistance. *Meded. Landbouwhogeschool, Wageningen* 59, 1–68.
- Gaff, D. F. (1971). Desiccation-tolerant flowering plants in Southern Africa. Science 174, 1033-1034.
- Gaff, D. F. (1977). Desiccation tolerant vascular plants of South Africa. Oecologia 31, 95-109.
- Gaff, D. F., and Churchill, D. M. (1976). Borya nitida Labill: An Australian species in the Liliaceae with desiccation-tolerant leaves. Aust. J. Bot. 24, 209-224.
- Gaiser, R. N. (1952). Root channels and roots in forest soils. Soil Sci. Soc. Am. Proc. 16, 62-65.
- Galau, G. A., Hughes, D. W., and Dure, L., III (1986). Abscisic acid induction of cloned cotton late embryogenesis-abundant (Lea) mRNAs. *Plant Mol. Biol.* 7, 155–170.

- Gale, J., and Hagan, R. M. (1966). Plant antitranspirants. Annu. Rev. Plant Physiol. 17, 269-282.
 Gales, K. (1979). Effects of water supply on partitioning of dry matter between roots and shoots in Lolium perenne. J. Appl. Ecol. 16, 863-877.
- Gambles, R. L., and Dengler, N. G. (1974). The leaf anatomy of hemlock, *Tsuga canadensis*. Can. J. Bot. **52**, 1049–1056.
- Ganns, R. A., Zasada, J. C., and Phillips, C. (1981). Sap production of paper birch in the Tanana Valley, Alaska. For. Chron. 58, 19-22.
- Gardner, B. R., Blad, B. L., and Watts, D. G. (1981). Plant and air temperatures in differentially irrigated corn. Agric. Meteorol. 25, 207-217.
- Gardner, W. R. (1958). Some steady state solutions of the unsaturated moisture flow equation with application to evaporation from a water table. Soil Sci. 85, 228-237.
- Gardner, W. R. (1960). Dynamic aspects of water availability to plants. Soil Sci. 89, 63-73.
- Gardner, W. R., and Ehlig, C. F. (1962). Impedance to water movement in soil and plant. *Science* 138, 522-523.
- Gardner, W. R., and Fireman, M. (1958). Laboratory studies of evaporation from soil columns in the presence of a water table. Soil Sci. 85, 244-249.
- Gardner, W. R., and Nieman, R. H. (1964). Lower limit of water availability to plants. Science 143, 1460–1462.
- Garrity, D. P., Watts, D. G., Sullivan, C. Y., and Gilley, J. R. (1982). Moisture deficits and grain sorghum performance: Evapotranspiration-yield relationships. *Agron. J.* 74, 815–820.
- Gartner, B. L. (1991). Stem hydraulic properties of vines vs. shrubs of western poison oak, *Toxico-dendron diversloburn*. Oecologia 87, 180–189.
- Gartner, B. L., Bullock, S. H., Mooney, H. A., Brown, V. B., and Whitbeck, J. L. (1990). Water transport properties of vine and tree stems in a tropical deciduous forest. *Am. J. Bot.* 77, 742-749.
- Gates, D. M. (1968). Transpiration and leaf temperature. Annu. Rev. Plant Physiol. 19, 211–238.
- Gates, D. M. (1980). "Biophysical Ecology." Springer-Verlag, New York.
- Gerdemann, J. W. (1968). Vesicular-arbuscular mycorrhiza and plant growth. Annu. Rev. Phyto-pathology 6, 397-418.
- Geurten, I. (1950). Untersuchungen über den Gaswechsel von Baumrinden. Forstwiss. Centrolbl. 69, 704-743.
- Gibbs, J. W. (1875–1876). On the equilibrium of heterogeneous substances. *Trans. Conn. Acad. Sci.* III, 108–248.
- Gibbs, J. W. (1931). "The Collected Works of J. Willard Gibbs," Vol. 1. Longmans, Green and Co., New York.
- Gibeaut, D. M., and Carpita, N. C. (1991). Tracing cell wall biogenesis in intact cells and plants. Plant Physiol. 97, 551–561.
- Giddings, J. L. (1962). Development of tree-ring dating as an archeology aid. *In* "Tree Growth" (T. T. Kozlowski, ed.), pp. 119–132. Ronald Press, New York.
- Gifford, R. M. (1979). Growth and yield of CO₂-enriched wheat under water-limited conditions. Aust. J. Plant Physiol. 6, 367–378.
- Gilbert, D. E., Myer, J. L., Kessler, J. J., La Vine, P. D., and Carlson, C. V. (1970). Evaporative cooling of vineyards. *Calif. Agric.* 24, 12-14.
- Giles, K. L., Beardsell, M. F., and Cohen, D. (1974). Cellular and ultrastructural changes in mesophyll and bundle sheath cells of maize in response to water stress. *Plant Physiol.* 54, 208–212.
- Giles, K. L., Cohen, D., and Beardsell, M. F. (1976). Effects of water stress on the ultrastructure of leaf cells of Sorghum bicolor. Plant Physiol. 57, 11-14.
- Gill, W. R., and Bolt, G. H. (1955). Pfeffer's studies of the root growth pressures exerted by plants. Agron. J. 47, 166-168.
- Gimenez, C., Mitchell, V. J., and Lawlor, D. W. (1992). Regulation of photosynthetic rate of two sunflower hybrids under water stress. *Plant Physiol.* 98, 516-524.

- Gimmler, H., and Möller, E.-M. (1981). Salinity-dependent regulation of starch and glycerol metabolism in *Dunaliella parva*. *Plant Cell Environ*. 4, 367–375.
- Gindel, I. (1973). "A New Ecophysiological Approach to Forest-Water Relationships in Arid Climates." Junk, The Hague.
- Ginsburg, H., and Ginzburg, B. Z. (1970). Radial water and solute flows in the roots of Zea mays. J. Exp. Bot. 21, 580-592.
- Givnish, T. J. (1986). Optimal stomatal conductance, allocation of energy between leaves and roots, and the marginal cost of transpiration. In "On the Economy of Plant Form and Function" (T. J. Givnish, ed.), pp. 171–213. Cambridge University Press, Cambridge, UK.
- Glinski, J., and Lipiec, J. (1990). "Soil Physical Conditions and Plant Roots." CRC Press, Boca Raton, FL.
- Glinski, J., and Stepniewski, W. (1985). "Soil Aeration and its Role for Plants." CRC Press, Boca Raton, FL.
- Gollan, T., Passioura, J. B., and Munns, R. (1986). Soil water status affects the stomatal conductance of fully turgid wheat and sunflower leaves. *Aust. J. Plant Physiol.* 13, 459-464.
- Gortner, R. A. (1938). "Outlines of Biochemistry." 2nd Ed. Wiley, New York.
- Gowing, D. J. G., Davies, W. J., and Jones, H. G. (1990). A positive root-sourced signal as an indicator of soil drying in apple, *Malus x domestica* Borkh. J. Exp. Bot. 41, 1535-1540.
- Gowing, D. J. G., Davies, W. J., Trejo, C. L., and Jones, H. G. (1993). Xylem-transported chemical signals and the regulation of plant growth and physiology. *Phil. Trans. Roy. Soc. London Ser. B* 341, 41-47.
- Graan, T., and Boyer, J. S. (1990). Very high CO₂ partially restores photosynthesis in sunflower at low water potentials. *Planta* 181, 378–384.
- Gračanin, M. (1963). Über Unterscheide in der Transpiration von Blattspreite und Stamm. *Phyton* 10, 216-224.
- Grace, J. (1977). "Plant Response to Wind." Academic Press, New York.
- Gradmann, H. (1928). Untersuchungen über die Wasserverhältnisse des Bodens als Grundlage des Pflanzenwachstums. *Jahrb. Wiss. Bot.* **69**, 1–100.
- Graham, D., and Smillie, R. M. (1976). Carbonate dehydratase in marine organisms of the Great Barrier Reef. Aust. I. Plant Physiol. 3, 113-119.
- Graham, J. H., Syvertsen, J. P., and Smith, M. G., Jr. (1987). Water relations of mycorrhizal and phosphorus-fertilized nonmycorrhizal Citrus under drought stress. New Phytol. 105, 441-419.
- Graham, L. E. (1985). The origin of the life cycle of land plants. Am Sci. 73, 178-186.
- Graham, T. (1862). Liquid diffusion applied to analysis. Phil. Trans. Roy. Soc. London 151, 183– 224.
- Granier, A., Bobay, V., Gash, J. H. C., Gelpe, J., Saugier, B., and Shuttleworth, W. J. (1990). Vapour flux density and transpiration rate comparisons in a stand of Maritime pine (*Pinus pinaster Ait.*) in Les Lander forest. *Agric. For. Meteorol.* 51, 309-319.
- Grant, M. C. (1993). The trembling giant. Discover 14, 82-89.
- Grantz, D. A., Graan, T., and Boyer, J. S. (1985a). Chloroplast function in guard cells of *Vicia faba* L.: Measurement of the electrochromic absorbance change at 518 nm. *Plant Physiol.* 77, 956–962.
- Grantz, D. A., Ho, T. D., Uknes, S. J., Cheeseman, J. M., and Boyer, J. S. (1985b). Metabolism of abscisic acid in guard cells of *Vicia faba* L. and *Commelina communis* L. *Plant Physiol.* 78, 51-56.
- Gray, A. (1868). "Lessons in Botany and Vegetable Physiology." Ivison, Blakeman and Taylor, New York.
- Greacen, E. L., and Oh, J. S. (1972). Physics of root growth. Nature New Biol. 235, 24-25.
- Greaves, J. E., and Carter, E. G. (1923). The influence of irrigation water on the composition of grains and the relationship to nutrition. *J. Biol. Chem.* 58, 531-541.
- Green, J. R. (1914). "A History of Botany in the United Kingdom From the Earliest Times to the End of the 19th Century." J. M. Dent & Sons, Ltd., London.

- Green, P. B. (1958). Concerning the site of the addition of new wall substances to the elongating *Nitella* cell wall. *Am. J. Bot.* 45, 111-116.
- Green, P. B., Erickson, R. O., and Buggy, J. (1971). Metabolic and physical control of cell elongation rate: In vivo studies in Nitella. Plant Physiol. 47, 423–430.
- Green, W. N., Ferrier, J. M., and Dainty, J. (1979). Direct measurement of water capacity of Beta vulgaris storage tissue sections using a displacement transducer, and resulting values for cell membrane hydraulic conductivity. Can. J. Bot. 57, 921-985.
- Greenidge, K. N. H. (1957). Ascent of sap. Annu. Rev. Plant Physiol. 8, 237-256.
- Greenidge, K. N. H. (1958). A note on the rates of upward travel of moisture in trees under differing experimental conditions. *Can. J. Bot.* 36, 357–361.
- Greenwood, D. J. (1967). Studies on the transport of oxygen through the stems and roots of vegetable seedlings. *New Phytol.* 66, 337-347.
- Gregoriou, C., and Economides, C. V. (1993). Tree growth, yield and fruit quality of Ortanique tangor in eleven rootstocks in Cyprus. J. Am. Soc. Hort. Sci. 118, 335-338.
- Gregory, F. G., and Pearse, H. L. (1934). The resistance porometer and its application to the study of stomatal movement. *Proc. Roy. Soc.* (London) **B114**, 477-493.
- Gregory, P. J., Lake, J. V., and Rose, D. A., eds. (1987). "Root Development and Function." Cambridge University Press, Cambridge, England.
- Grier, C. C., Vogt, K. A., Keyes, M. R., and Edmonds, R. L. (1981). Biomass distribution and aboveand below-ground production in young and mature Abies amabilis zone ecosystems of the Washington Cascades. Can. J. For. Res. 11, 155-167.
- Gries, G. A. (1943). Juglone (5-hydroxy-1,4-naphthoquinone): A promising fungicide. Phyto-pathology 33, 1112.
- Grimmond, C. S. B., Isard, S. A., and Belding, M. J. (1992). Development and evaluation of continuously weighing mini-lysimeters. Agric. For. Meteorol. 62, 205-218.
- Groot, A., and King, K. M. (1992). Measurement of sap flow by the heat balance method: Numerical analysis and application to coniferous seedlings. *Agric. For. Meteorol.* **59**, 289–308.
- Grose, M. J., and Hainsworth, J. M. (1992). Soil water extraction, measured by computer-assisted tomography, in seedling *Lupinus angustifolius* cv. Yandee when healthy and infected with *Phytophthora cinnamomi*. J. Exp. Bot. 43, 121-127.
- Grosse, W., Büchel, H. B., and Tiebel, H. (1991). Pressurized ventilation in wetland plants. *Aquatic Bot.* 39, 89–98.
- Grosse, W., Frye, J., and Latterman, S. (1992). Root aeration in wetland trees by pressurized gas transport. *Tree Physiol.* 10, 285-295.
- Grumet, R., and Hanson, A. D. (1986). Genetic evidence for an osmoregulatory function of glycinebetaine accumulation in barley. *Aust. J. Plant Physiol.* 13, 353–364.
- Guerin, V., Trinchant, J.-C., and Rigaud, J. (1990). Nitrogen fixation (C₂H₂ reduction) by broad bean (*Vicia faba* L.) nodules and bacteroids under water-restricted conditions. *Plant Physiol.* 92, 595-601.
- Guerrero, F. D., Jones, J. T., and Mullet, J. E. (1990). Turgor-responsive gene transcription and RNA levels increase rapidly when pea shoots are wilted: Sequence and expression of three inducible genes. *Plant Mol. Biol.* 15, 11–26.
- Gunasekera, D., and Berkowitz, G. A. (1992). Heterogeneous stomatal closure in response to leaf water deficits is not a universal phenomenon. *Plant Physiol.* 98, 660-665.
- Gunasekera, D., and Berkowitz, G. A. (1993). Use of transgenic plants with ribulose-1,5-bisphosphate carboxylase/oxygenase antisense DNA to evaluate the rate limitation of photosynthesis under water stress. *Plant Physiol.* 103, 629–635.
- Gunning, B. E. S., Steer, M. W., and Cochrane, M. P. (1968). Occurrence, molecular structure and induced formation of the "stroma centre" in plastids. J. Cell Sci. 3, 445–456.
- Gupta, A. S., and Berkowitz, G. A. (1987). Osmotic adjustment, symplast volume, and nonstomatally mediated water stress inhibition of photosynthesis in wheat. *Plant Physiol.* 85, 1040– 1047.

- Gurr, C. G. (1962). Use of gamma rays in measuring water content and permeability in unsaturated columns of soil. Soil Sci. 94, 224–229.
- Gurr, C. G., Marshall, T. J., and Hutton, J. T. (1952). Movement of water in soil due to a temperature gradient. Soil Sci. 74, 335-345.
- Guttenberger, M., and Hampp, R. (1992). Ectomycorrhizins: Symbiosis-specific or artifactual polypeptides from ectomycorrhizas? *Planta* 188, 129–142.
- Haas, A. R. C. (1948). Effect of the rootstock on the composition of citrus trees and fruit. *Plant Physiol.* 23, 309-330.
- Hagan, R. M. (1949). Autonomic diurnal cycles in the water relations of nonexuding detopped root systems. Plant Physiol. 24, 441–454.
- Hagan, R. M., Haise, H. R., and Edminster, T. W., eds. (1967). "Irrigation of Agricultural Lands." Amer. Soc. Agron., Madison, WI.
- Hagan, R. M., Vaadia, Y., and Russell, M. B. (1959). Interpretation of plant responses to soil moisture regimes. Adv. Agron. 11, 77-98
- Hajibagheri, M. A., and Flowers, T. J. (1989). X-ray microanalysis of ion distribution within root cortical cells of the halophyte Suaeda maritima (L.) Dum. Planta 177, 131-134.
- Hajibagheri, M. A., Gilmour, D. J., Collins, J. C., and Flowers, T. J. (1986). X-ray microanalysis and ultrastructural studies of cell compartments of *Dunaliella parva*. J. Exp. Bot. 37, 1725–1732.
- Hales, S. (1727). "Vegetable Staticks." W. & J. Innys and T. Woodward, London. [Reprinted by Scientific Book Guild, London.]
- Hall, A. E., Chandler, W. F., Van Bavel, C. H. M., Reid, P. H., and Anderson, J. H. (1953). A tracer technique to measure growth and activity of plant root systems. N.C. Agric. Exp. Sta. Tech. Bull. 101.
- Hall, A. E., and Grantz, D. A. (1981). Drought resistance of cowpea improved by selecting for early appearance of mature pods. *Crop Sci.* 21, 461-464.
- Hall, A. E., and Kaufman, M. R. (1975). Stomatal response to environment with Sesamum indicum L. Plant Physiol. 55, 455-459.
- Hallam, A. (1984). Pre-quaternary sea-level changes. Annu. Rev. Earth Planet. Sci. 12, 205-243.
- Hallam, N. D., and Gaff, D. F. (1978a). Regeneration of chloroplast structure in *Talbotia elegans*: A desiccation tolerant plant. *New Phytol.* 81, 657-662.
- Hallam, N. D., and Gaff, D. F. (1978b). Re-organization of fine structure during rehydration of desiccated leaves of Xerophyta villosa. New Phytol. 81, 349-355.
- Ham, J. M., and Heilman, J. L. (1990). Dynamics of a heat balance stem flow gauge during high flow. Agron. J. 82, 147-152.
- Hamada, S., Ezaki, S., Hayashi, K., Toko, K., and Yamafuji, K. (1992). Electric current precedes emergence of a lateral root in higher plants. *Plant Physiol.* 100, 614-619.
- Hamblin, A. P. (1985). The influence of soil structure on water movement, crop root growth and water uptake. Adv. Agron. 38, 95-158.
- Hammel, H. T. (1967). Freezing of xylem sap without cavitation. Plant Physiol. 42, 55-66.
- Hammel, H. T. (1976). Colligative properties of a solution. Science 192, 748-756.
- Hammel, H. T., and Scholander, P. F. (1976). "Osmosis and Tensile Solvent." Springer-Verlag, Berlin.
- Hangarter, R. P., Grandoni, P., and Ort, D. R. (1987). The effects of chloroplast coupling factor reduction on the energetics and efficiency of ATP formation. J. Biol. Chem. 262, 13513-13519.
- Hanson, A. D., and Hitz, W. D. (1982). Metabolic responses of mesophytes to plant water deficits. Annu. Rev. Plant Physiol. 33, 163-203.
- Hanson, B. R., and Dickey, G. L. (1993). Field practices affect neutron moisture meter accuracy. Calif Agric. 47, 29-31.
- Hanson, P. J., Sucoff, E. I., and Markhart, A. H., III (1985). Quantifying apoplastic flux through red pine root systems using trisodium, 3-hydroxy-5,8,10-pyrenetrisulfonate. *Plant Physiol.* 77, 21-24.

- Harada, J. J., DeLisle, A. J., Baden, C. S., and Crouch, M. L. (1989). Unusual sequence of an abscisic acid-inducible mRNA which accumulates late in *Brassica napus* seed development. *Plant Mol-Biol.* 12, 395-401.
- Harborne, J. B. (1988). "Introduction to Ecological Biochemistry," 3rd Ed. Academic Press, London...
- Harding, R. B., Miller, M. P., and Fireman, M. (1958). Absorption of salts by citrus leaves during sprinkling with water suitable for surface irrigation. *Proc. Am. Soc. Hort. Sci.* 71, 248–256.
- Harley, J. L., and Smith, S. E. (1983). "Mycorrhizal Symbiosis." Academic Press, New York.
- Harmond, U., Schaesberg, N., Graham, J., and Syvertsen, J. (1987). Salinity and flooding stress effects on VAM and non-VAM citrus rootstock seedlings. *Plant Soil* 104, 37–43.
- Harris, D. G. (1971). Simultaneous measurements of solution absorption, transpiration, relative plant water content and growth. *Agron. J.* 63, 840-845.
- Harris, J. A. (1934). "The Physico-chemical Properties of Plant Saps in Relation to Phytogeography." University of Minnesota Press, Minnesota.
- Harris, M. J., and Outlaw, W. H., Jr. (1991). Rapid adjustment of guard-cell abscisic acid levels to current leaf-water status. *Plant Physiol.* 95, 171-173.
- Harris, W. F., Kinerson, R. S., Jr., and Edwards, N. T. (1977). Comparison of below-ground biomass of natural deciduous forests and loblolly pine plantations. Range Sci. Dep. Sci. Ser. (Colo. State Univ.), Fort Collins, CO.
- Hartenstein, R. (1986). Earthworm biotechnology and global biogeochemistry. Adv. Ecol. Res. 15, 379-409.
- Hartwig, U., Boller, B. C., Baur-Hoch, B., and Nosberger, J. (1990). The influence of carbohydrate reserves in the response of nodulated white clover to defoliation. *Ann. Bot.* 65, 97–105.
- Hasegawa, S. (1986). Changes in soil water contents in the vicinity of soybean roots. Trans. 13th Congr. Int. Soc. Soil Sci. 2, 73-74.
- Hasegawa, S., and Sato, T. (1987). Water uptake by roots in cracks and water movement in clayey subsoil. Soil Sci. 143, 381-386.
- Hashimoto, Y., Ino, T., Kramer, P. J., Naylor, A. W., and Strain, B. R. (1984). Dynamic analysis of water stress of sunflower leaves by means of a thermal image processing system. *Plant Physiol.* 76, 266-269.
- Hashimoto, Y., Kramer, P. J., Nonami, H., and Strain, B. R., eds. (1990). "Measurement Techniques in Plant Science." Academic Press, San Diego.
- Hatch, M. D., and Burnell, J. N. (1990). Carbonic anhydrase activity in leaves and its role in the first step of C₄ photosynthesis. *Plant Physiol.* 93, 825–828.
- Häussling, M., Jorns, C. A., Lehmbecker, G., Hecht-Buchholz, C., and Marschner, H. (1988). Ion and water uptake in relation to root development in Norway spruce (*Picea abies* (L.) Karst). *J. Plant Physiol.* 133, 486-491.
- Hayashi, T. (1989). Xyloglucans in the primary cell wall. Annu. Rev. Plant Physiol. Plant Mol. Biol. 40, 139-168.
- Hayward, H. E., and Long, E. M. (1942). The anatomy of the seedling and roots of the Valencia orange. U.S. Dep. Agric. Tech. Bull. 786.
- Hayward, H. E., Long, E. M., and Uhvits, R. (1946). Effect of chloride and sulfate salts on the growth and development of the Elberta peach on Shalil and Lovell rootstocks. U.S. Dept. Agr. Tech. Bull. 922.
- Hayward, H. E., and Spurr, W. B. (1943). Effects of osmotic concentration of substrate on the entry of water into corn roots. *Bot. Gaz.* 105, 152–164.
- Hayward, H. E., and Spurr, W. (1944). Effects of isosmotic concentrations of inorganic and organic substrates on entry of water into corn roots. *Bot. Gaz.*. 106, 131-139.
- Head, G. C. (1964). A study of "exudation" from the root hairs of apple roots by time-lapse cine-photomicrography. *Ann. Bot.* 28, 495–498.
- Head, G. C. (1967). Effects of seasonal changes in shoot growth on the amount of unsuberized root on apple and plum trees. J. Hort. Sci. 42, 169–180.

- Hecht-Buchholz, Ch., and Foy, C. D. (1981). Effect of aluminum toxicity on root morphology of barley. In "Structure and Function of Plant Roots" (R. Brouwer, O. Gasparikova, J. Kolek, and B. G. Loughman, eds.), pp. 343-345. Nijhoff/Junk, The Hague.
- Heeramon, D. A., and Juma, N. G. (1993). A comparison of minirhizotron, core, and monolith methods for quantifying barley (*Hordeum vulgare* L.) and faba bean (*Vicia faba* L.) root distribution. *Plant Soil* 148, 29-41.
- Hegde, R. S., and Miller, D. A. (1990). Allelopathy and autotoxicity in alfalfa: Characterization and effects of preceding crops and residue incorporation. *Crop Sci.* 30, 1255–1259.
- Hegde, R. S., and Miller, D. A. (1992). Scanning electron microscopy for studying root morphology and anatomy in alfalfa autotoxicity. *Agron. J.* 84, 618–620.
- Heimovaara, T. J. (1993). Design of triple-wire time domain reflectometry probes in practice and theory. J. Soil Sci. Soc. Am. 57, 1410-1417.
- Hellkvist, J., Richards, G. P., and Jarvis, P. G. (1974). Vertical gradients of water potential and tissue water relations in Sitka spruce trees measured with the pressure chamber. J. Appl. Ecol. 11, 637-667.
- Hellmers, H., Horton, J. S., Juhren, G., and O'Keefe, J. (1955). Root systems of some chaparral plants in southern California. *Ecology* 36, 667-678.
- Henderson, L. J. (1913). "The Fitness of the Environment." The Macmillan Co., New York.
- Hepler, P. K., and Wayne, R. O. (1985). Calcium and plant development. Annu. Rev. Plant Physiol. 36, 397-439.
- Herkelrath, W. N., Miller, E. E., and Gardner, W. R. (1977). Water uptake by plants. II. The root contact model. Soil Sci. Soc. Am. J. 41, 1039-1043.
- Herrero, M. P., and Johnson, R. R. (1981). Drought stress and its effect on maize reproductive systems. Crop Sci. 21, 105-110.
- Hershey, D. R. (1990). Container-soil physics and plant growth. BioScience 40, 685.
- Hewlett, J. D. (1961). Soil moisture as a source of base flow from steep mountain watersheds. U.S. Dept. Agr. Forest Serv., Southeastern Forest Exp. Sta. Paper 132.

- Hewlett, J. D., and Hibbert, A. R. (1961). Increases in water yield after several times of forest cutting. Int. Assoc. Sci. Hydrol. Bull. 6, 5-17.
- Heyl, J. G. (1933). Der Einfluss von Aussenfaktoren auf das Bluten der Pflanzen. *Planta* 20, 294–353.
- Hilbert, J.-L., Costa, G., and Martin, F. (1991). Ectomycorrhizin synthesis and polypeptide changes during the early stage of Eucalypt mycorrhiza development. *Plant Physiol.* 97, 977–984.
- Hiler, E. A., and Clark, R. N. (1971). Stress day index to characterize effects of water stress on crop yields. *Trans. A.S.A.E.* 14, 757-761.
- Hillel, D. (1980a). "Fundamentals of Soil Physics." Academic Press, New York.
- Hillel, D. (1980b). "Applications of Soil Physics." Academic Press, New York.
- Hirasawa, T., Gotou, T., and Ishihara, K. (1992). On resistance to water transport from roots to the leaves at the different positions on a stem in rice plants. *Japan. J. Crop Sci.* 61, 153-158.
- Hirasawa, T., Iida, Y., and Ishihara, K. (1988). Effect of leaf water potential and air humidity on photosynthetic rate and diffusive conductance in rice plants. *Japan. J. Crop Sci.* 57, 112-118.
- Hite, D. R. C., Outlaw, W. H., Jr., and Tarczynski, M. C. (1993). Elevated levels of both sucrose-phosphate synthase and sucrose synthase in *Vicia* guard cells indicate cell-specific carbohydrate interconversions. *Plant Physiol.* 101, 1217–1221.
- Ho, T. Y., and Mishkind, M. L. (1991). The influence of water deficits on mRNA levels in tomato. *Plant Cell Environ.* 14, 67-75.
- Hodgson, R. H. (1953). "A Study of the Physiology of Mycorrhizal Roots on *Pinus taeda* L." M.A. Thesis, Duke University, Durham, NC.
- Hodnett, M. G. (1986). The neutron probe for soil moisture measurement. *In* "Advanced Agricultural Instrumentation" (W. G. Gensler, ed.), pp. 148–192. M. Nijhoff Publisher, Dordrecht.

- Hoffman, G. T., Rawlins, S. L., Garber, M. J., and Cullen, E. M. (1971). Water relations and growth of cotton as influenced by salinity and relative humidity. *Agron. J.* 63, 822-826.
- Hofmeister, W. (1862). Ueber Spannung, Ausflusemenge und Ausflusegeschwindigheit von Säften lebender Pflanzen. Flora 45, 97-108, 113-120, 138-144, 145-152, 170-175.
- Holbrook, N. M., Burns, M. J., and Sinclair, T. R. (1992). Frequency and time-domain dielectric measurements of stem water content in the arborescent palm, Sabal palmetto. J. Exp. Bot. 43, 111-119.
- Holch, A. E. (1931). Development of roots and shoots of certain deciduous tree seedlings in different forest sites. *Ecology* 12, 259–298.
- Hole, D. J., Cobb, B. G., Hole, P. S., and Drew, M. C. (1992). Enhancement of anaerobic respiration in root tips of *Zea mays* following low-oxygen (hypoxic) acclimation. *Plant Physiol.* 99, 213–218.
- Hollaender, A. (ed.) (1956). "Radiation Biology." McGraw-Hill, New York.
- Holland, H. D. (1978). "The Chemistry of Oceans and Atmospheres." Wiley, New York.
- Holland, H. D. (1984). "The Chemical Evolution of the Atmosphere and Oceans." Princeton University Press, Princeton, NJ.
- Holmgren, P., Jarvis, P. G., and Jarvis, M. S. (1965). Resistances to carbon dioxide and water vapour transfer in leaves of different plant species. *Physiol. Plant.* 18, 557-573.
- Honert, T. H. van den (1948). Water transport in plants as a catenary process. *Disc. Faraday Soc.* 3, 146–153.
- Hong, B., Uknes, S. J., and Ho, T.-H. D. (1988). Cloning and characterization of a cDNA encoding a mRNA rapidly-induced by ABA in barley aleurone layers. *Plant Mol. Biol.* 11, 495-506.
- Hook, D. D., Brown, C. L., and Kormanik, P. P. (1971). Inductive flood tolerance in swamp tupelo (Nyssa sylvatica var. biflora [Walt.] Sarg.). J. Exp. Bot. 22, 78-89.
- Hoover, M. D. (1944). Effect of removal of forest vegetation upon water yield. *Trans. Am. Geophys. Union* 25, 969-977.
- Hoover, M. D. (1949). Hydrologic characteristics of South Carolina Piedmont forest soils. *Proc. Soil Sci. Soc. Am.* 14, 353-358.
- Hooymans, J. J. M. (1969). The influence of the transpiration rate on uptake and transport of potassium in barley plants. *Planta* 88, 369-371.
- Horst, W. J., Wagner, A., and Marschner, H. (1982). Mucilage protects root meristems from aluminum injury. Z. Pflanzenphysiol. 105, 435-444.
- Hough, W. A., Woods, F. W., and McCormack, M. L. (1965). Root extension of individual trees in surface soils of a natural longleaf pine-turkey oak stand. For. Sci. 11, 223–242.
- Howard, A. (1925). The effect of grass on trees. Roy. Soc. London Proc. B97, 284-321.
- Hsiao, T. C. (1970). Rapid changes in levels of polyribosomes in Zea mays in response to water stress. Plant Physiol. 46, 281-285.
- Hsiao, T. C. (1973). Plant responses to water stress. Annu. Rev. Plant Physiol. 24, 519-570.
- Hsiao, T. C., Acevedo, E., and Henderson, D. W. (1970). Maize leaf elongation: Continuous measurements and close dependence on plant water status. *Science* 168, 590–591.
- Hsiao, T. C., Acevedo, E., Fereres, E., and Henderson, D. W. (1976). Water stress, growth, and osmotic adjustment. *Phil. Trans. Roy. Soc. London Ser. B* 273, 479-500.
- Hsiao, T. C., Allaway, W. G., and Evans, L. T. (1973). Action spectra for guard cell Rb⁺ uptake and stomatal opening in *Vicia faba*. *Plant Physiol.* 51, 82–88.
- Hsu, S.-T., and Goodman, R. N. (1978). Production of a host-specific, wilt-inducing toxin in apple cell suspension cultures inoculated with *Erwinia amylovora*. *Phytopathology* 68, 351–354.
- Huang, C. Y., Boyer, J. S., and Vanderhoef, L. N. (1975a). Acetylene reduction (nitrogen fixation) and metabolic activities of soybean having various leaf and nodule water potentials. *Plant Physiol.* 56, 222–227.
- Huang, C. Y., Boyer, J. S., and Vanderhoef, L. N. (1975b). Limitation of acetylene reduction (nitro-

- gen fixation) by photosynthesis in soybean having low water potentials. *Plant Physiol.* 56, 228-232.
- Huang, R. S., Smith, W. K., and Yost, R. S. (1985). Influence of vesicular-arbuscular mycorrhiza on growth, water relations, and leaf orientation in *Leucaena leucocephala* (Lam.) DeWit. New Phytol. 99, 229-243.
- Huang, Y.-H., and Morris, J. T. (1991). Evidence for hygrometric pressurization in the internal gas space of Spartina alterniflora. Plant Physiol. 96, 166-171.
- Huber, B. (1924). Die Beurteilung des Wasserhaushaltes der Pflanze. *Jahrb. Wiss. Bot.* 64, 1–120. Huber, B. (1932). Beobachtung und Messung pflanzlichen Saftströme. *Ber. deut. bot. Ges.* 50, 89–
- Huber, B. (1935). Die physiologische Bedeutung der Ring- und Zerstreutporigkeit. Ber. deut. bot. Ges. 53, 711-719.
- Huber, B. (1956). Die Transpiration von Sprossachsen und anderen nicht foliosen Organen. In "Encycl. Plant Physiol.," Vol. 3, pp. 427–435. Springer-Verlag, Berlin.
- Huber, B., and Schmidt, E. (1937). Eine Kompensations-methode zur thermoelektrischen Messung Langsamer Saftstrome. Ber. deut. bot. Ges. 50, 514-529.
- Hubick, K., and Farquhar, G. (1990). Carbon isotope discrimination and the ratio of carbon gained to water lost in barley cultivars. *Plant Cell Environ.* 12, 795-804.
- Hubick, K. T., Farquíhar, G. D., and Shorter, R. (1986). Correlation between water-use efficiency and carbon isotope discrimination in diverse peanut (*Arachis*) germplasm. *Aust. J. Plant Physiol.* 13, 803-816.
- Huck, M. G. (1970). Variation in taproot elongation rate as influenced by composition of the soil air. Agron. J. 62, 815-818.
- Huck, M. G. (1983). Root distribution, growth, and activity with reference to agroforestry. In "Plant Research and Agroforestry" (P. A. Huxley, ed.), pp. 527-542. Int. Council for Res. in Agroforestry, Nairobi, Kenya.
- Huck, M. G., Klepper, B., and Taylor, H. M. (1970). Diurnal variations in root diameter. *Plant Physiol.* 45, 529-530.
- Huckenpahler, B. J. (1936). Amount and distribution of moisture in a living shortleaf pine. J. For. 34, 399-401.
- Hudson, J. P. (1960). Relations between root and shoot growth in tomatoes. Sci. Hort. 14, 49-54.
- Huffaker, R. C., Radin, T., Kleinkopf, G. E., and Cox, E. L. (1970). Effects of mild water stress on enzymes of nitrate assimilation and of the carboxylative phase of photosynthesis in barley. Crop Sci. 10, 471-474.
- Hull, H. M., Wright, L. N., and Bleckmann, C. A. (1978). Epicuticular wax ultrastructure among lines of *Eragrostis lehmanniana* Nees developed for seedling drouth tolerance. *Crop Sci.* 18, 699-704.
- Hulugalle, N. R., and Willatt, S. T. (1983). The role of soil resistance in determining water uptake by plant root systems. *Aust. J. Soil Res.* 21, 571–574.
- Hunt, S., King, B. J., Canvin, D. T., and Layzell, D. B. (1987). Steady and nonsteady state gas exchange characteristics of soybean nodules in relation to the oxygen diffusion barrier. *Plant Physiol.* 84, 164-172.
- Hunt, S., and Layzell, D. B. (1993). Gas exchange of legume nodules and the regulation of nitrogenase activity. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 44, 483-511.
- Hurd, E. A. (1974). Phenotype and drought tolerance in wheat. Agric. Meteorol. 14, 39-55.
- Hüsken, D., Steudle, E., and Zimmermann, U. (1978). Pressure probe technique for measuring water relations of cells in higher plants. *Plant Physiol.* 61, 158-163.
- Hylmö, B. (1953). Transpiration and ion absorption. Physiol. Plant. 6, 333-405.
- Idso, S. B., and Baker, D. G. (1967). Relative importance of reradiation, convection, and transpiration in heat transfer from plants. *Plant Physiol.* 42, 631–640.

- Idso, S. B., Clawson, K. L., and Anderson, M. G. (1986). Foliage temperature: Effects on environmental factors with implications for plant water stress assessment and the CO₂ climate connection. Water Resour. Res. 22, 1702-1716.
- Ihle, J. N., and Dure, L., III (1972). Developmental biochemistry of cottonseed embryogenesis and germination. III. Regulation of the biosynthesis of enzymes utilized in germination. J. Biol. Chem. 247, 5048-5055.
- Imber, D., and Tal, M. (1970). Phenotypic reversion of flacca, a wilty mutant of tomato, by abscisic acid. Science 169, 592-593.
- Imsande, J., and Touraine, B. (1994). N demand and the regulation of nitrate uptake. *Plant Physiol.* 105, 3-7.
- Incoll, L. D., Long, S. P., and Ashmore, M. R. (1977). SI units in publications in plant science. Curr. Adv. Plant Sci. 9, 331–343.
- Ingle, J., Joy, K. W., and Hageman, R. H. (1966). The regulation of activity of the enzymes involved in the assimilation of nitrate by higher plants. *Biochem. J.* 100, 577-588.
- Inoue, Y., Kimball, B. A., Jackson, R. D., and Pinter, P. J., Jr. (1990). Remote estimation of leaf transpiration rate and stomatal resistance based on IR thermometry. Agr. For. Meteorol. 51, 21-34.
- Irigoyen, J. J., Emerich, D. W., and Sánchez-Díaz, M. (1992a). Phosphoenolpyruvate carboxylase, malate and alcohol dehydrogenase activities in alfalfa (*Medicago sativa*) nodules under water stress. *Physiol. Plant.* 84, 61–66.
- Irigoyen, J. J., Emerich, D. W., and Sánchez-Díaz, M. (1992b). Water stress induced changes in concentrations of proline and total soluble sugars in nodulated alfalfa (*Medicago sativa*) plants. *Physiol. Plant.* 84, 55–60.
- Irigoyen, J. J., Sánchez-Díaz, M., and Emerich, D. W. (1992c). Transient increase of anaerobically-induced enzymes during short-term drought of alfalfa root nodules. J. Plant Physiol. 139, 397-402.
- Isebrands, J. G., Promnitz, L. C., and Dawson, D. H. (1977). Leaf area development in short rotation intensive cultured *Populus* plots. TAPPI For. Biol. Wood Chem. Conf. (Conf. Pap.), pp. 201–209.
- Ishihara, K., Iida, O., Hirasawa, T., and Ogura, T. (1978). Relationship between potassium content in leaf blades and stomatal aperture in rice plants. *Japan. J. Crop Sci.* 47, 719-720.
- Israel, D. W., Giddens, J. E., and Powell, W. W. (1973). The toxicity of peach tree roots. *Plant Soil* 39, 103-112.
- Itai, C., and Vaadia, Y. (1965). Kinetin-like activity in root exudate of water-stressed sunflower plants. *Physiol. Plant.* 18, 941–944.
- Itoh, S., and Barber, S. A. (1983). Phosphorus uptake by six plant species as related to root hairs. *Agron. J.* 75, 457-461.
- Ivanov, V. B. (1980). Specificity of spatial and time organization of root cell growth in connection with functions of the root. *Soviet Plant Physiol.* 26(5, P+1), 720-728.
- Iwata, S., Tabuchi, T., and Warkentin, B. P. (1988). "Soil-Water Interactions: Mechanisms and Applications." Dekker, New York.
- Jaafar, M. N., Stone, L. R., and Goodrum, D. E. (1993). Rooting depth and dry matter development of sunflower. *Agron. J.* 85, 281-286.
- Jachetta, J. J., Appleby, A. P., and Boersma, L. (1986). Use of the pressure vessel to measure concentrations of solutes in apoplastic and membrane-filtered symplastic sap in sunflower leaves. *Plant Physiol.* 82, 995-999.
- Jackson, M. B. (1985). Ethylene and responses of plants to soil waterlogging and submergence. Annu. Rev. Plant Physiol. 36, 145-174.
- Jackson, M. B. (1991). Regulation of water relationships in flooded plants by ABA from leaves, roots and xylem sap. In "Abscisic Acid" (W. J. Davies and H. G. Jones, eds.), pp. 217–226. Bios Scientific Publications, Oxford, U.K.

- Jackson, M. B., Davies, D. D., and Lambers, H. (eds.) (1991). "Plant Life under Oxygen Deprivation." SPB Publ. Co., The Hague.
- Jackson, M. B., and Hall, K. C. (1987). Early stomatal closure in water logged pea plants is mediated by abscisic acid in the absence of foliar water deficits. *Plant Cell Environ*. 10, 121-130.
- Jackson, M. B., Herman, B., and Goodenough, A. (1982). An examination of the importance of ethanol in causing injury to flooded plants. *Plant Cell Environ.* 5, 163–172.
- Jackson, M. B., Young, S. F., and Hall, K. C. (1988). Are roots a source of abscisic acid for the shoots of flooded pea plants? J. Exp. Bot. 39, 1631-1637.
- Jackson, R. D. (1982). Canopy temperature and plant water stress. Adv. Irrig. 7, 43-85.
- Jackson, W. T. (1955). The role of adventitious roots in recovery of shoots following flooding of the original root systems. Am. J. Bot. 42, 816-819.
- Jacobsen, J. V., Hanson, A. D., and Chandler, P. C. (1986). Water stress enhances expression of an α-amylase gene in barley leaves. *Plant Physiol.* 80, 350-359.
- Jacoby, G. C., Jr., Sheppard, P. R., and Sieh, K. E. (1988). Irregular occurrence of large earthquakes along the San Andreas fault: Evidence from trees. Science 241, 196-199.
- Jamison, V. C. (1946). The penetration of irrigation and rain water into sandy soils of central Florida. Soil Sci. Soc. Am. Proc. 10, 25-29.
- Janes, B. E. (1948). The effect of varying amounts of irrigation on the composition of two varieties of snap beans. *Proc. Amer. Soc. Hort. Sci.* 51, 457-462.
- Janos, D. P. (1980). Vesicular-arbuscular mycorrhizae affect lowland tropical rain forest plant growth. Ecology 61, 151-162.
- Jäntti, A., and Kramer, P. J. (1957). Regrowth of pastures in relation to soil moisture and defoliation. In "Proc. Seventh Int. Grasslands Congr.," pp. 1-12.
- Jarvis, P. G. (1985). Transpiration and assimilation of tree and agricultural crops: The "omega" factor. In "Trees as Crop Plants" (M. G. R. Cornell and J. E. Jackson, eds.), pp. 461-480. Inst. Terrestrial Ecol., Huntingdon, England.
- Jarvis, P. G., and Mansfield, T. A., eds. (1981). "Stomatal Physiology." Cambridge University Press, Cambridge, UK.
- Jarvis, P. G., and McNaughton, K. G. (1986). Stomatal control of transpiration: Scaling up from leaf to region. Adv. Ecol. Res. 15, 1-49.
- Jarvis, P. G., Rose, C. W., and Begg, J. E. (1967). An experimental and theoretical comparison of viscous and diffusive resistances to gas flow through amphistomatous leaves. Agr. Meteorol. 4, 103-117.
- Jarvis, P. G., and Slatyer, R. O. (1966). A controlled environment chamber for studies of gas exchange by each surface of a leaf. CSIRO Div. Land Res., Tech. Paper 29.
- Jarvis, P. G., and Slatyer, R. O. (1970). The role of the mesophyll cell wall in leaf transpiration. Planta 90, 303-322.
- Jeffree, C. E., Johnson, R. P. C., and Jarvis, P. G. (1971). Epicuticular wax in the stomatal antechamber of Sitka spruce and its effects on the diffusion of water vapour and carbon dioxide. *Planta* 98, 1-10.
- Jemison, G. M. (1944). The effect of basal wounding by forest fires on the diameter growth of some southern Appalachian hardwoods. Duke Univer. School Forestry Bull. 9.
- Jenks, M. A., Joly, R. J., Peters, P. J., Rich, P. J., Axtell, J. D., and Ashworth, E. N. (1994). Chemically induced cuticle mutation affecting epidermal conductance to water vapor and disease susceptibility in Sorghum bicolor (L.) Moench. Plant Physiol. 105, 1239–1245.
- Jenne, E. A., Rhoades, H. F., Yien, C. H., and Howe, O. W. (1958). Change in nutrient element accumulation by corn with depletion of soil moisture. *Agron. J.* 50, 71–74.
- Jenner, C. F., Xia, Y., Eccles, C. D., and Callaghan, P. T. (1988). Circulation of water within wheat grain revealed by nuclear magnetic resonance micro-imaging. *Nature* (London) 336, 399-402.
- Jenniskens, P., and Blake, D. F. (1994). Structural transitions in amorphous water ice and astrophysical implications. Science 265, 753-756.

- Jenny, H., and Grossenbacher, K. (1963). Root-soil boundary zones as seen in the electron microscope. Soil Sci. Soc. Am. Proc. 27, 273-277.
- Jensen, S. D., and Cavalieri, A. J. (1983). Drought tolerance in U.S. maize. In "Plant Production and Management under Drought Conditions" (J. F. Stone and W. O. Willis, eds.), pp. 223-236. Developments in Agricultural and Managed-Forest Ecology 12, Elsevier Science Publishers, New York.
- Johansen, A., Jacobsen, I., and Jensen, E. S. (1993). External hyphae of vesicular-arbuscular mycorrhizal fungi associated with *Trifolium subterraneum* L. 3. Hyphal transport of ³²P and ¹⁵N. New Phytol. 124, 61-68.
- Johns, D., Beard, J. B., and Van Bavel, C. H. M. (1983). Resistances to evapotranspiration from a St. Augustinegrass turf canopy. *Agron. J.* 75, 419-422.
- Johnson, G. A., Brown, J., and Kramer, P. J. (1987). Magnetic resonance microscopy of changes in water content in stems of transpiring plants. *Proc. Natl. Acad. Sci. USA* 84, 2752-2755.
- Johnson, H. B. (1975). Plant pubescence: An ecological perspective. Bot. Rev. 41, 233-258.
- Johnson, I. R., Melkonian, J. J., Thornley, J. H. M., and Riha, S. J. (1991). A model of water flow through plants incorporating shoot/root "message" control of stomatal conductance. *Plant Cell Environ.* 14, 531–544.
- Johnson, I. R., and Thornley, J. H. M. (1987). A model of shoot:root partitioning with optimal growth. *Ann. Bot.* 60, 133-142.
- Johnson, J. F., Allan, D. L., and Vance, C. P. (1994). Phosphorus stress-induced proteoid roots show altered metabolism in *Lupinus albus*. *Plant Physiol*. 104, 657-665.
- Johnson, J. O. (1984). A rapid technique for estimating total surface area of pine needles. For. Sci. 30, 913-921.
- Johnson, L. P. V. (1945). Physiological studies on sap flow in the sugar maple, Acer-saccharum Marsh. Can. J. Res. Sec. C. 23, 192-197.
- Johnson, N. C., Copeland, P. J., Crookston, R. K., and Pfleger, F. L. (1992). Mycorrhizae: Possible explanation for yield decline with continuous corn and soybean. *Agron. J.* 84, 387–390.
- Johnson, R. R., Frey, N. M., and Moss, D. N. (1974). Effect of water stress on photosynthesis and transpiration of flag leaves and spikes of barley and wheat. *Crop Sci.* 14, 728-731.
- Johnson, R. R., and Moss, D. N. (1976). Effect of water stress on ¹⁴CO₂ fixation and translocation in wheat during grain filling. *Crop Sci.* 16, 697–701.
- Johnson, R. W., Tyree, M. T., and Dixon, M. A. (1987). A requirement for sucrose in xylem sap flow from dormant maple trees. *Plant Physiol.* 84, 495-500.
- Jones, C. G., Edson, A. W., and Morse, W. J. (1903). The maple sap flow. Bull. 103, Vermont Agric. Exp. Sta.
- Jones, H. G., Hamer, P. J. C., and Higgs, K. H. (1988a). Evaluation of various heat-pulse methods for estimation of sap flow in orchard trees: Comparison with micro-meteorological estimates of evaporation. *Trees* 2, 250–260.
- Jones, H. G., and Higgs, K. H. (1980). Resistance to water loss from the mesophyll cell surface in plant leaves. J. Exp. Bot. 31, 545-553.
- Jones, H. G., Leigh, R. A., Wyn Jones, R. G., and Tomos, A. D. (1988b). The integration of wholeroot and cellular hydraulic conductivities in cereal roots. *Planta* 174, 1-7.
- Jones, H. G., Tomos, A. D., Leigh, R. A., and Wyn Jones, R. G. (1983). Water-relation parameters of epidermal and cortical cells in the primary root of *Triticum aestivum L. Planta* 158, 230-236.
- Jones, M. M., and Turner, N. C. (1978). Osmotic adjustment in leaves of sorghum in response to water deficits. *Plant Physiol.* 61, 122-126.
- Jordan, W. R., Miller, F. R., and Morris, D. E. (1979). Genetic variation in root and shoot growth of sorghum in hydroponics. *Crop Sci.* 19, 468–472.
- Jordan, W. R., and Ritchie, J. T. (1971). Influence of soil water stress on evaporation, root absorption, and internal water status of cotton. *Plant Physiol.* 48, 783-788.

- Joshi, M. C., Boyer, J. S., and Kramer, P. J. (1965). Growth, carbon dioxide exchange, transpiration, and transpiration ratio of pineapple. Bot. Gaz. 126, 174-179.
- Jupp, A. P., and Newman, E. I. (1987). Morphological and anatomical effects of severe drought on the roots of *Lolium perenne L. New Phytol.* 105, 393-402.
- Jurgens, S. K., Johnson, R. R., and Boyer, J. S. (1978). Dry matter production and translocation in maize subjected to drought during grain fill. *Agron. J.* 70, 678-682.
- Kaiser, W. M. (1987). Effects of water deficit on photosynthetic capacity. *Physiol. Plant.* 71, 142-149.
- Kaiser, W. M., Schröppel-Meier, G., and Wirth, E. (1986). Enzyme activities in an artificial stroma medium: An experimental model for studying effects of dehydration on photosynthesis. *Planta* 167, 292–299.
- Kalela, A. (1954). Mantysiemenpuiden japuustojen juuroisuhteista (On root relations of pine seed trees). Acta For. Fenn. 61, 1-17.
- Kamiya, N., and Tazawa, M. (1956). Studies on water permeability of a single plant cell by means of transcellular osmosis. *Protoplasma* 46, 394-422.
- Kamiya, N., Tazawa, M., and Takata, T. (1963). The relation of turgor pressure to cell volume in *Nitella* with special reference to mechanical properties of the cell wall. *Protoplasma* 57, 501-521.
- Kanemasu, E. T., Thurtell, G. W., and Tanner, C. B. (1969). Design, calibration and field use of a stomatal diffusion porometer. *Plant Physiol.* 44, 881–885.
- Kargol, M. (1992). The graviosmotic hypothesis of xylem transport of water in plants. Gen. Physiol. Biophys. 11, 469-487.
- Karsten, K. S. (1939). Root activity and the oxygen requirement in relation to soil fertility. Am. J. Bot. 26, 855-860.
- Kasuga, M. C. M., Muchovej, R. M. C., and Muchovej, J. J. (1990). Influence of aluminum on in vitro formation of *Pinus caribaea* mycorrhizae. *Plant Soil* 124, 73-77.
- Katz, C., Oren, R., Schulze, E.-D., and Milburn, J. A. (1989). Uptake of water and solutes through twigs of *Picea abies* (L.) Karst. *Trees* 3, 33-37.
- Kaufmann, M. R. (1968). Water relations of pine seedlings in relation to root and shoot growth. *Plant Physiol.* 43, 281-288.
- Kaufmann, M. R. (1976). Stomatal response of Engelmann spruce to humidity, light, and water stress. *Plant Physiol.* 57, 899-901.

- Kaufmann, M. R. (1981). Automatic determination of conductance, transpiration, and environmental conditions in forest trees. For. Sci. 27, 817-827.
- Kaufmann, M. R. (1982). Evaluation of season, temperature, and water stress effects on stomata using a leaf conductance model. *Plant Physiol.* **69**, 1023–1026.
- Kaufmann, M. R. (1984). A canopy model (RM-CWU) for determining transpiration of subalpine forests. I. Model development. *Can. J. For. Res.* 14, 218-226.
- Kaufmann, M. R. (1985). Annual transpiration in subalpine forests: Large differences among four tree species. For. Ecol. & Mngt. 13, 235-246.
- Kaufmann, M. R., and Fiscus, E. L. (1985). Water transport through plants: Internal integration of edaphic and atmospheric effects. *Acta Hort*. 171, 83-93.
- Kaufmann, M., R., and Landsberg, J. J., eds. (1991). "Advancing Toward Closed Models of Forest Ecosystems." Heron Publishing, Victoria, B.C., Canada.
- Kaufmann, M. R., and Troendle, C. A. (1981). The relationship of leaf area and foliage biomass to sapwood conducting area in four subalpine forest tree species. For. Sci. 27, 477-482.
- Kauss, H. (1983). Volume regulation in Poterioochromonas. Plant Physiol. 71, 169-172.
- Kauss, H., and Thomson, K.-S. (1982). Biochemistry of volume control in *Poterioochromonas*. In "Plasmalemma and Tonoplast: Their Functions in the Plant Cell" (D. Marmé, E. Marrè, and R. Hertel, eds.), pp. 255–261. Elsevier Biomedical Press, B.V.

- Kavanau, J. L. (1964). "Water and Solute-Water Interactions." Holden-Day, Inc., San Francisco.
- Kawamitsu, Y., Agata, W., and Miura, S. (1987). Effects of vapour pressure difference on CO₂ assimilation rate, leaf conductance and water use efficiency in grass species. *J. Fac. Agr. Kyushu Univ.* 31, 1-10.
- Kawase, M. (1979). Role of cellulase in aerenchyma development in sunflower. Am. J. Bot. 66, 183-190.
- Kearns, E. V., and Assman, S. M. (1993). The guard cell-environment connection. *Plant Physiol.* 102, 711-715.
- Keck, R. W., and Boyer, J. S. (1974). Chloroplast response to low leaf water potentials. III. Differing inhibition of electron transport and photophosphorylation. *Plant Physiol.* 53, 474–479.
- Kedem, O., and Katchalsky, A. (1958). Thermodynamic analysis of the permeability of biological membranes to non-electrolytes. *Biochim. Biophys. Acta* 27, 229–246.
- Keever, C. (1950). Causes of succession on old fields of the Piedmont, North Carolina. Ecol. Monogr. 20, 229-250.
- Keller, R. (1930). Der elektrische Faktor des Wassertransporte in Luhte der Vitalfarbung. Ergeb. Physiol. 30, 294–407.
- Kende, H. (1965). Kinetinlike factors in the root exudate of sunflowers. Proc. Natl. Acad. Sci. USA 53, 1302-1307.
- Ketring, D. L., and Reid, J. L. (1993). Growth of peanut roots under field conditions. Agron. J. 85, 80–85.
- Kevekordes, K. G., McCully, M. E., and Canny, M. J. (1988). Later maturation of large metaxylem vessels in soybean roots: Significance for water and nutrient supply to the shoot. *Ann. Bot.* 62, 105-117.
- Khalil, A. A. M., and Grace, J. (1993). Does xylem sap ABA control the stomatal behaviour of water-stressed sycamore (*Acer pseudoplatanus* L.) seedlings? J. Exp. Bot. 44, 1127-1134.
- Kiesselbach, T. A., Russell, J. C., and Anderson, A. (1929). The significance of subsoil moisture in alfalfa production. J. Am. Soc. Agron. 21, 241-268.
- Killian, Ch., and Lemée, G. (1956). Les xerophytes: Leur économie d'eau. Encyl. Plant Physiol. 3, 787-824.
- Kimmerer, T. W., and MacDonald, R. C. (1987). Acetaldehyde and ethanol biosynthesis in leaves of plants. *Plant Physiol.* 84, 1204–1209.
- Kimmerer, T. W., and Stringer, M. A. (1988). Alcohol dehydrogenase and ethanol in stems of trees. Plant Physiol. 87, 693-697.
- King, B. J., Hunt, S., Weagle, G. E., Walsh, K. B., Pottier, R. H., Canvin, D. T., and Layzell, D. B. (1988). Regulation of O₂ concentration in soybean nodules observed by *in situ* spectroscopic measurement of leghemoglobin oxygenation. *Plant Physiol.* 87, 296–299.
- King. D. A. (1993). A model analysis of the influence of root and foliage allocation on forest production and competition between trees. *Tree Physiol.* 12, 119–135.
- Kinman, C. F. (1932). A preliminary report on root growth studies with some orchard trees. Proc. Am. Soc. Hort. Sci. 29, 220-224.
- Kirkham, M. B., Gardner, W. R., and Gerloff, G. C. (1972). Regulation of cell division and cell enlargement by turgor pressure. *Plant Physiol.* 49, 961–962.
- Kitano, M., and Eguchi, H. (1992a). Dynamics of whole-plant water balance and leaf growth in response to evaporative demand. I. Effect of change in irradiance. *Biotronics* 21, 39–50.
- Kitano, M., and Eguchi, H. (1992b). Dynamics of whole-plant water balance and leaf growth in response to evaporative demand. II. Effect of change in wind velocity. *Biotronics* 21, 51-60.
- Kitano, M., and Eguchi, H. (1993). Dynamic analyses of water relations and leaf growth in cucumber plants under midday water deficit. *Biotronics* 22, 73-85.
- Klebs, G. (1910). Alterations in the development and forms of plants as a result of environment. Proc. Roy. Soc. London 82B, 547-558.

- Klebs, G. (1913). Über das Verhaltnisse der Aussenwelt zur Entwicklung der Pflanzen. Sitzber. Heidelberg Akad. Wiss. Abt. B5, 1-47.
- Klepper, B., and Kaufmann, M. R. (1966). Removal of salt from xylem sap by leaves and stems of guttating plants. *Plant Physiol.* 41, 1743-1747.
- Klepper, B., Taylor, H. M., Huck, M. G., and Fiscus, E. L. (1973). Water relations and growth of cotton in drying soil. Agron. J. 65, 307-310.
- Klotz, I. M. (1958). Protein hydration and behavior. Science 128, 815-822.
- Kluge, M., and Ting, I. P. (1978). "Crassulacean Acid Metabolism." Springer-Verlag, Berlin.
- Knight, D. H., Fahey, T. J., Running, S. W., Harrison, A. T., and Wallace, L. L. (1981). Transpiration from 100-year old lodgepole pine forests estimated with whole tree potometers. *Ecology* 62, 717-726.
- Knoerr, K. R. (1967). Contrasts in energy balances between individual leaves and vegetated surfaces. *In* "International Symposium on Forest Hydrology" (W. E. Sopper and H. W. Lull, eds.), pp. 391–401. Pergamon Press, New York.
- Koch, A. L. (1990). Growth and form of the bacterial cell wall. Amer. Sci. 78, 327-341.
- Koeppe, D. E., Miller, R. J., and Bell, D. T. (1973). Drought-affected mitochondrial processes as related to tissue and whole plant responses. *Agron. J.* 65, 566–569.
- Koide, R. T., and Schreiner, R. P. (1992). Regulation of vesicular-arbuscular mycorrhizal symbiosis. Annu. Rev. Plant Physiol. Plant Mol. Biol. 43, 557-591.
- Kokubo, A., Kuraishi, S., and Sakurai, N. (1989). Culm strength of barley: Correlation among maximum bending stress, cell wall dimensions, and cellulose content. *Plant Physiol.* 91, 876– 882.
- Kokubo, A., Sakurai, N., Kuraishi, S., and Takeda, K. (1991). Culm brittleness of barley (*Hordeum vulgare* L.) mutants is caused by smaller number of cellulose molecules in cell wall. *Plant Physiol.* 97, 509-514.
- Kolata, G. B. (1979). Water structure and ion binding: a role in cell physiology? *Science* 192, 1220–1222.
- Kolattukudy, P. E. (1981). Structure, biosynthesis, and biodegradation of cutin and suberin. *Annu. Rev. Plant Physiol.* 32, 539-567.
- Korstian, C. F. (1924). Density of cell sap in relation to environmental conditions in the Wasatch Mountains of Utah. J. Agr. Res. 28, 845-909.
- Koster, K. L., and Leopold, A. C. (1988). Sugars and desiccation tolerance in seeds. *Plant Physiol.* 88, 829-832.
- Kozlowski, T. T., ed. (1968). "Water Deficits and Plant Growth," Vol. 2. Academic Press, New York
- Kozlowski, T. T., ed. (1972). "Water Deficits and Plant Growth," Vol. 3. Academic Press, New York.
- Kozlowski, T. T., ed. (1973). "Shedding of Plant Parts." Academic Press, New York.
- Kozlowski, T. T., ed. (1976). "Water Deficits and Plant Growth," Vol. 4. Academic Press, New York.
- Kozlowski, T. T., ed. (1978). "Water Deficits and Plant Growth," Vol. 5. Academic Press, New York.
- Kozlowski, T. T., ed. (1984). "Flooding and Plant Growth." Academic Press, Orlando, FL.
- Kozlowski, T. T., and Cooley, J. C. (1961). Root grafting in northern Wisconsin. J. For. 59, 105-107.
- Kozlowski, T. T., Kramer, P. J., and Pallardy, S. G. (1991). "The Physiological Ecology of Woody Plants." Academic Press, San Diego.
- Kozlowski, T. T., and Winget, C. H. (1963). Patterns of water movement in forest trees. Bot. Gaz. 124, 301-311.
- Kramer, P. J. (1932). The absorption of water by root systems of plants. Am. J. Bot. 19, 148-164.

- Kramer, P. J. (1933). The intake of water through dead root systems and its relation to the problem of absorption by transpiring plants. Am. J. Bot. 20, 481-492.
- Kramer, P. J. (1937). The relation between rate of transpiration and rate of absorption of water in plants. Am. J. Bot. 24, 10-15.
- Kramer, P. J. (1938). Root resistance as a cause of the absorption lag. Am. J. Bot. 25, 110-113.
- Kramer, P. J. (1939). The forces concerned in the intake of water by transpiring plants. Am. J. Bot. 26, 784-791.
- Kramer, P. J. (1940a). Causes of decreased absorption of water by plants in poorly aerated media. Am. J. Bot. 27, 216-220.
- Kramer, P. J. (1940b). Root resistance as a cause of decreased water absorption by plants at low temperatures. *Plant Physiol.* 15, 63-79.
- Kramer, P. J. (1940c). Sap pressure and exudation. Am. J. Bot. 27, 929-931.
- Kramer, P. J. (1942). Species differences with respect to water absorption at low soil temperatures. Am. J. Bot. 29, 828-832.
- Kramer, P. J. (1945). Absorption of water by plants. Bot. Rev. 11, 310-355.
- Kramer, P. J. (1949). "Plant and Soil Water Relationships." McGraw-Hill, New York.
- Kramer, P. J. (1950). Effects of wilting on the subsequent intake of water by plants. Am. J. Bot. 37, 280-284.
- Kramer, P. J. (1951). Causes of injury to plants resulting from flooding of the soil. *Plant Physiol.* 26, 722-736.
- Kramer, P. J. (1955). Bound water. *In* "Encyclopedia of Plant Physiology" (W. Ruhland, ed.), Vol. 1, pp. 223–242. Springer-Verlag, Berlin.
- Kramer, P. J. (1963). Water stress and plant growth. Agron. J. 55, 31-35.
- Kramer, P. J. (1969). "Plant and Soil Water Relationships: A Modern Synthesis." McGraw-Hill, New York.
- Kramer, P. J. (1983). "Water Relations of Plants." Academic Press, New York.
- Kramer, P. J. (1987). The role of water stress in tree growth. J. Arboric. 13, 33-38.
- Kramer, P. J. (1988). Changing concepts regarding plant water relations. *Plant Cell Environ.* 11, 565-568.
- Kramer, P. J., and Bullock, H. C. (1966). Seasonal variations in the proportions of suberized and unsuberized roots of trees in relation to the absorption of water. *Am. J. Bot.* 53, 200–204.
- Kramer, P. J., and Clark, W. S. (1947). A comparison of photosynthesis in individual pine needles and entire seedlings at various light intensities. *Plant Physiol.* 22, 51–57.
- Kramer, P. J., and Coile, T. S. (1940). An estimation of the volume of water made available by root extension. *Plant Physiol.* 15, 743-747.
- Kramer, P. J., and Decker, J. P. (1944). Relation between light intensity and rate of photosynthesis of loblolly pine and certain hardwoods. *Plant Physiol.* 19, 350–358.
- Kramer, P. J., and Kozlowski, T. T. (1960). "Physiology of Trees." McGraw-Hill, New York.
- Kramer, P. J., and Kozlowski, T. T. (1979). "Physiology of Woody Plants." Academic Press, New York.
- Kramer, P. J., and Rose, R. W., Jr. (1986). Physiological characteristics of loblolly pine seedlings in relation to field performance. *In* "Proc. Int. Symp. on Nursery Management Practices for the Southern Pines" (D. B. South, ed.), pp. 416–440. Auburn University, Auburn, Alabama.
- Kramer, P. J., and Wiebe, H. H. (1952). Longitudinal gradients of P³² absorption in roots. *Plant Physiol.* 27, 661-674.
- Kriedemann, P. E., and Downton, W. J. S. (1981). Photosynthesis. In "The Physiology and Biochemistry of Drought Resistance in Plants" (L. G. Paleg and D. Aspinall, eds.), pp. 283-314. Academic Press, Sydney.
- Kriedemann, P. E., Loveys, B. R., Fuller, G. L., and Leopold, A. C. (1972). Abscisic acid and stomatal regulation. Plant Physiol. 49, 842-847.

- Krizek, D. T., and Dubik, S. P. (1987). Influence of water stress and restricted root volume on growth and development of urban trees. J. Arboric. 13, 47-55.
- Kuntz, I. D., and Kauzmann, W. (1974). Hydration of proteins and polypeptides. Adv. Protein Chem. 28, 239-345.
- Kuntz, J. E., and Riker, A. J. (1955). The use of radioactive isotopes to ascertain the role of root grafting in the translocation of water, nutrients, and disease-inducing organisms. Proc. Int. Conf. Peaceful Uses At. Energy 12, 144-148.
- Kurkova, E. B., and Motorina, M. V. (1974). Chloroplast ultrastructure and photosynthesis at different rates of dehydration. Sov. Plant Physiol. 21, 28-31.
- Kurtzman, R. H., Jr. (1966). Xylem sap flow as affected by metabolic inhibitors and girdling. Plant Physiol. 41, 641-646.
- Kutschera, L. (1960). "Wurzelatlas Mitteleuropäischer Ackerunkräuter und Kulturpflanzen." DLG Verlag, Frankfurt-am-Main.
- Kutschera, U. (1989). Growth, in vivo extensibility and tissue tension in mung bean seedlings subjected to water stress. Plant Sci. 61, 1-7
- Kutschera, U., and Briggs, W. R. (1987). Rapid auxin-induced stimulation of cell wall synthesis in pea internodes. Proc. Natl. Acad. Sci. USA 84, 2747-2751.
- Kutschera, U., and Briggs, W. R. (1988). Growth, in vivo extensibility, and tissue tension in developing pea internodes. Plant Physiol. 86, 306-311.
- Laan, P., and Blom, C. W. P. M. (1990). Growth and survival response of Rumex species to flooded and submerged conditions: The importance of shoot elongation, underwater photosynthesis and reserve carbohydrates. J. Exp. Bot. 41, 775-783.
- Laan, P., Tosserams, M., Blom, C. W. P. M., and Veen, B. W. (1990). Internal oxygen transport in Rumex spp. and its significance for respiration under hypoxic conditions. Plant Soil 122, 39-46.
- Labavitch, J. M., and Ray, P. M. (1974). Relationship between promotion of xyloglucan metabolism and induction of elongation by indoleacetic acid. Plant Physiol. 54, 499-502.
- Ladefoged, K. (1963). Transpiration of forest trees. Physiol. Plant. 16, 378-414.
- Laing, H. E. (1940). The composition of the internal atmosphere of Nuphar advenum and other water plants. Am. J. Bot. 27, 861-868.
- Laisk, A. (1983). Calculations of leaf photosynthetic parameters considering the statistical distribution of stomatal aperture. L. Exp. Bot. 34, 1627–1635.
- Laisk, A., Oja, V., and Kull, K. (1980). Statistical distribution of stomatal apertures of Vicia faba and Hordeum vulgare and the Spannungsphase of stomatal opening. J. Exp. Bot. 31, 49-58.
- Lamhamedi, M. S., Bernier, P. Y., and Fortin, J. A. (1992). Hydraulic conductance and soil water potential at the soil-root interface of Pinus pinaster seedlings inoculated with different dikaryons of Pisolithus sp. Tree Physiol. 10, 231-244.
- Landsberg, J. J., and Fowkes, N. D. (1978). Water movement through plant roots. Ann. Bot. 42, 493-508.
- Lang, A. (1990). Xylem, phloem and transpiration flows in developing apple fruits. J. Exp. Bot. 41, 645-651.
- Lange, O. L., Kappen, L., and Schulze, E.-D., eds. (1976). "Water and Plant Life," Vol. 19. Springer-Verlag, Berlin
- Lange, O. L., Lösch, R., Schulze, E.-D., and Kappen, L. (1971). Responses of stomata to changes in humidity. Planta 100, 76-86.
- Larson, P. R. (1980). Interrelations between phyllotaxis, leaf development and the primarysecondary vascular transition in Populus deltoides. Ann. Bot. 46, 757-769.
- LaRue, C. D. (1930). The water supply of the epidermis of leaves. Papers Mich. Acad. Sci. 13, 131 - 139.
- LaRue, C. D. (1952). Root grafting in tropical trees. Science 115, 296.
- Lassoie, J. P., Fetcher, N., and Solo, D. J. (1977a). Stomatal infiltration pressures versus potom-

- eter measurements of needle resistance in Douglas-fir and lodgepole pine. Can. J. For. Res. 7, 192-196.
- Lassoie, J. P., and Hinckley, T. M. (1991). "Techniques and Approaches in Forest Tree Ecophysiology." CRC Press, Boca Raton, FL.
- Lassoie, J. P., Scott, D. R. M., and Fritschen, L. J. (1977b). Transpiration studies in Douglas-fir using the heat pulse technique. For. Sci. 23, 377-380.
- Lauer, M. J., and Boyer, J. S. (1992). Internal CO₂ measured directly in leaves: Abscisic acid and low leaf water potential cause opposing effects. *Plant Physiol.* 98, 1310-1316.
- Lawlor, D. W. (1970). Absorption of polyethylene glycols by plants and their effects on plant growth. New Phytol. 69, 501-513.
- Lawlor, D. W. (1993). "Photosynthesis: Molecular, Physiological and Environmental Processes," 2nd Ed. Longman Scientific & Technical, Essex.
- Lawlor, D. W., and Milford, G. F. J. (1975). The control of water and carbon dioxide flux in waterstressed sugar beet. J. Exp. Bot. 26, 657-665.
- Layzell, D. B., Hunt, S., and Palmer, G. R. (1989). Mechanism of nitrogenase inhibition in soybean nodules. *Plant Physiol.* 92, 1101–1107.
- Lazof, D. B., Rufty, T. W., Jr., and Redinbaugh, M. G. (1992). Localization of nitrate absorption and translocation within morphological regions of the corn root. *Plant Physiol.* 100, 1251– 1258.
- Lebedeff, A. F. (1928). The movement of ground and soil waters. Proc. 1st Int. Cong. Soil Sci. 1, 459-494.
- Lemon, E. R., ed. (1983). "CO₂ and Plants." Am. Assoc. Adv. Sci., Washington, D.C.
- Leon, J. M., and Bukovac, M. J. (1978). Cuticle development and surface morphology of olive leaves with reference to penetration of foliar-applied chemicals. J. Amer. Hort. Sci. 103, 465-472.
- Leopold, A. C., Musgrave, M. E., and Williams, K. M. (1981). Solute leakage resulting from leaf desiccation. Plant Physiol. 68, 1222-1225.
- Leshem, B. (1965). The annual activity of intermediary roots of the Aleppo pine. For. Sci. 11, 291-298.
- Letey, J., Clark, P. R., and Amrhein, C. (1992). Water-sorbing polymers do not conserve water. Calif. Agric. 46(3), 9-10.
- Letey, J., Welch, N., Pelishek, R. E., and Osborn, J. (1962). Effects of wetting agents on irrigation of water repellent soils. *Calif. Agric.* 16, 213.
- Levitt, J. (1980). "Responses of Plants to Environmental Stresses," Vol. 2, pp. 25-92. Academic Press, New York.
- Levitt, J., Scarth, G. W., and Gibbs, R. D. (1936). Water permeability of isolated protoplasts in relation to volume change. *Protoplasma* 26, 237-248.
- Levy, Y., and Kaufmann, M. R. (1976). Cycling of leaf conductance in citrus exposed to natural and controlled environments. *Can. J. Bot.* 54, 2215–2218.
- Lewis, F. J. (1945). Physical condition of the surface of the mesophyll cell walls of the leaf. *Nature* (London) 156, 407-409.
- Liebig, J. (1841). "Organic Chemistry in its Application to Agriculture and Physiology." English Translation by J. Owen, Cambridge, UK.
- Lieffers, V. J., and Rothwell, R. L. (1987). Rooting of peatland black spruce and tamarack in relation to depth of water table. Can. J. Bot. 65, 817-821.
- Lin, C. H., and Lin, C. H. (1992). Physiological adaptation of waxapple to waterlogging. *Plant Cell Environ.* 15, 321-328.
- Lindblad, P., Rai, A. N., and Bergman, B. (1987). The Cycas revoluta-Nostoc symbiosis: Enzyme activities of nitrogen and carbon metabolism in the cyanobiont. J. Gen. Microbiol. 133, 1695–1699.
- Ling, G. N. (1969). A new model for the living cell: A summary of the theory and recent experimental evidence in its support. *Intern. Rev. Cytol.* 26, 1–61.

- Livingston, B. E. (1903). "The Role of Diffusion and Osmotic Pressure in Plants." University of Chicago Press, Chicago, IL.
- Livingston, B. E. (1918). Porous clay cones for the auto-irrigation of potted plants. *Plant World* 2, 202-208.
- Livingston, B. E. (1927). Plant water relations. Quart. Rev. Biol. 2, 494-515.
- Livingston, B. E., and Beall, R. (1934). The soil as a direct source of carbon dioxide for ordinary plants. *Plant Physiol.* 9, 237-259.
- Livingston, B. E., and Brown, W. H. (1912). Relation of the daily march of transpiration to variations in the water content of foliage leaves. *Bot. Gaz.* (Chicago) 53, 309-330.
- Livingston, B. E., and Shreve, F. (1921). "The Distribution of Vegetation in the United States as Related to Climatic Conditions." Carnegie Inst. Wash. Publ. 284.
- Lloyd, F. E. (1908). "The Behaviour of Stomata." Carnegie Inst. Washington Publ. 82.
- Lloyd, J., Syvertsen, J. P., and Kriedemann, P. E. (1987). Salinity effects on leaf water relations and gas exchange of 'Valencia' orange on rootstock with different salt exclusion characteristics. *Aust. J. Plant Physiol.* 14, 605-617.
- Lockard, R. G., and Schneider, G. W. (1981). Stock and scion growth relationships and the dwarfing mechanism in apples. *Hortic. Rev.* 3, 315-375.
- Lockhart, J. A. (1965a). An analysis of irreversible plant cell elongation. J. Theor. Biol. 8, 264-275.
- Lockhart, J. A. (1965b). Cell extension. *In* "Plant Biochemistry" (J. Bonner and J. E. Varner, eds.), pp. 826-849. Academic Press, New York.
- Loehwing, W. F. (1934). Physiological aspects of the effect of continuous soil aeration on plant growth. *Plant Physiol.* **9**, 567-583.
- Loescher, W., and Nevins, D. L. (1972). Auxin-induced changes in *Avena* coleoptile cell wall composition. *Plant Physiol.* 50, 556-563.
- Loescher, W. H., and Nevins, D. J. (1973). Turgor-dependent changes in *Avena* coleoptile cell wall composition. *Plant Physiol.* 52, 248-251.
- Loftfield, J. V. G. (1921). "The Behavior of Stomata." Carnegie Inst. Washington Publ. 314.
- Logsdon, S. D., Reneau, R. B., Jr., and Parker, J. C. (1987). Corn seedling root growth as influenced by soil physical properties. *Agron. J.* 79, 221-224.
- Longstreth, D. J., and Kramer, P. J. (1980). Water relations during flower induction and anthesis. *Bot. Gaz.* 141, 69-72.
- Lonnquist, J. H., and Jugenheimer, R. W. (1943). Factors affecting the success of pollination in corn. I. Am. Soc. Agron. 35, 923-933.
- Loomis, R. S., Williams, W. A., and Hall, A. E. (1971). Agricultural productivity. *Annu. Rev. Plant Physiol.* 22, 431-468.
- Loomis, W. E. (1935). The translocation of carbohydrates in maize. *Iowa State Coll. J. Sci.* 9, 509-520.
- Lopez, F. B., and Nobel, P. S. (1991). Root hydraulic conductivity of two cactus species in relation to root age, temperature, and soil water status. *J. Exp. Bot.* 42, 143–149.
- Lopushinsky, W. (1964). Effect of water movement on ion movement into the xylem of tomato roots. *Plant Physiol.* 39, 494-501.
- Lopushinsky, W. (1980). Occurrence of root pressure exudation in Pacific Northwest conifer seedlings. For. Sci. 26, 275-279.
- Lopushinsky, W. (1986). Seasonal and diurnal trends of heat pulse velocity in Douglas-fir and ponderosa pine. Can. J. For. Res. 16, 814-821.
- Lopushinsky, W., and Klock, G. O. (1974). Transpiration of conifer seedlings in relation to soil water potential. For. Sci. 20, 181-186.
- Lorio, P., Jr. (1993). Environmental stress and whole-tree physiology. In "Beetle-Pathogen Interactions in Conifer Forests" (T. D. Schowalter and G. M. Filip, eds.), pp. 81–101. Academic Press, London.

- Lorio, P. L., Jr. (1994). The relationship of oleoresin exudation pressure (or lack thereof) to flow from wounds. *J. Sustainable For.* 1, 81–93.
- Loustalot, A. J. (1945). Influence of soil-moisture conditions on apparent photosynthesis and transpiration of pecan leaves. *J. Agr. Res.* 71, 519-532.
- Lovett, G. M., Reiners, W. A., and Olson, R. K. (1982). Cloud droplet deposition in subalpine Balsam fir forests: hydrological and chemical inputs. *Science* 218, 1303–1304.
- Lowry, M. W., Huggins, W. C., and Forrest, L. A. (1936). "The Effect of Soil Treatment on the Mineral Composition of Exuded Maize Sap at Different Stages of Development." Georgia Agr. Exp. Sta. Bull. 193.
- Lucas, W. J., Ding, B., and van der Schoot, C. (1993). Plasmodesmata and the supracellular nature of plants. New Phytol. 125, 435-476.
- Ludevid, D., Höfte, H., Himelblau, E., and Chrispeels, M. J. (1992). The expression pattern of the tonoplast intrinsic protein τ-TIP in Arabidopsis thaliana is correlated with cell enlargement. Plant Physiol. 100, 1633–1639.
- Ludlow, M. M., and Björkman, O. (1984). Paraheliotropic leaf movement in Siratro as a protective mechanism against drought-induced damage to primary photosynthetic reactions: damage by excessive light and heat. *Planta* 161, 505-518.
- Lund, E. J. (1931). Electric correlation between living cells in cortex and wood in the Douglas fir. Plant Physiol. 6, 631-652.
- Lundegårdh, H. (1931). "Environment and Plant Development." English translation by Ashby Arnold, London.
- Lüthen, H., Bigdon, M., and Böttger, M. (1990). Reexamination of the acid growth theory of auxin action. *Plant Physiol.* 93, 931–939.
- Luxmoore, R. J., King, A. W., and Tharp, M. L. (1991). Approaches to scaling up physiologically based soil-plant models in space and time. *Tree Physiol.* 9, 281–292.
- Luxmoore, R. J., Stolzy, L. H., and Letey, J. (1970). Oxygen diffusion in the soil-plant system. III. Oxygen concentration profiles, respiration rates, and the significance of plant aeration predicted for maize roots. *Agron. J.* 62, 325-329.
- Lyford, W. H., and Wilson, B. F. (1964). Development of the root system of *Acer rubrum L. Harvard For. Paper* 10.
- Lynn, D. G., and Chang, M. (1990). Phenolic signals in cohabitation: implications for plant development. Annu. Rev. Plant Physiol. Plant Mol. Biol. 41, 497-526.
- Lyons, J. M. (1973). Chilling injury in plants. Annu. Rev. Plant Physiol. 24, 445-466.
- Lyons, J. M., Graham, D., and Raison, J. K., eds. (1979). "Low Temperature Stress in Crop Plants: The Role of the Membrane." Academic Press, New York.
- Lyr, H., and Hoffman, G. (1967). Growth rates and growth periodicity of tree roots. *Int. Rev. For. Res.* 2, 181–236.
- Maas, E. V. (1985). Crop tolerance to saline sprinkling waters. Plant Soil 89, 273-284.
- Maas, E. V. (1993). Salinity and citriculture. Tree Physiol. 12, 195-216.
- Macallum, A. B. (1905). On the distribution of potassium in animal and vegetable cells. J. Physiol. (London) 32, 95-128.
- MacDougal, D. T. (1926). "The Hydrostatic System of Trees." Carnegie Inst. Washington Publ., 373.
- MacFall, J. S. (1994). Effects of ectomycorrhizae on biogeochemistry and soil structure. *In* "Reappraisal of Mycorrhizae and Agriculture" (F. L. Pfleger and R. Linderman, eds.), pp. 213–238. APS Press, St. Paul, MN.
- MacFall, J. S., and Johnson, G. A. (1994). Use of magnetic resonance imaging in the study of plants and soils. *In* "Tomography for Measurement of Soil Physical Properties and Processes" (J. W. Hopmans and S. Anderson, eds.), pp. 99-113. Soil Sci. Soc. Am., Madison, WI.
- MacFall, J. S., Johnson, G. A., and Kramer, P. J. (1990). Observation of a water-depletion region

- surrounding loblolly pine roots by magnetic resonance imaging. Proc. Natl. Acad. Sci. USA 87, 1203-1207.
- MacFall, J. S., Johnson, G. A., and Kramer, P. J. (1991a). Comparative water uptake by roots of different ages in seedlings of loblolly pine (*Pinus taeda L.*). New Phytol. 119, 551-560.
- MacFall, J. S., Pfeffer, P. E., Rolin, D. B., MacFall, J. R., and Johnson, G. A. (1992). Observation of the oxygen diffusion barrier in soybean (Glycine max) nodules with magnetic resonance microscopy. Plant Physiol. 100, 1691-1697.
- MacFall, J. S., Slack, S. A., and Iyer, J. (1991c). Effects of *Hebeloma arenosa* and phosphorus fertility on root acid phosphatase activity of red pine (*Pinus resinosa*) seedlings. *Can. J. Bot.* 69, 380–383.
- MacFall, J. S., Slack, S. A., and Iyer, J. (1991b). Effects of *Hebeloma arenosa* and phosphorus fertility on growth of red pine (*Pinus resinosa*) seedlings. *Can. J. Bot.* 69, 372-379.
- MacFall, J. S., Slack, S. A., and Wehrli, S. (1992). Phosphorus distribution in red pine roots and the ectomycorrhizal fungus *Hebeloma arenosa*. *Plant Physiol.* 100, 713-717.
- Machlis L. (1944). The respiratory gradient in barley roots. Am. J. Bot. 31, 281-282.
- Madin, K. A. C., and Crowe, J. H. (1975). Anhydrobiosis in nematodes: Carbohydrate and lipid metabolism during dehydration. J. Exp. Zool. 193, 335-342.
- Maercker, U. (1965). Zur Kenntnis der Transpiration der Schliesszellen. *Protoplasma* 60, 61–78. Magistad, O. C., and Reitemeier, R. F. (1943). Soil solution concentrations at the wilting point and their correlation with plant growth. *Soil Sci.* 55, 351–360.
- Maier-Maercker, U. (1979a). Peristomatal transpiration and stomatal movement: A controversial view. I. Additional proof of peristomatal transpiration by hygrophotography and a comprehensive discussion in the light of recent results. Z. Pflanzenphysiol. 91, 25-43.
- Maier-Maercker, U. (1979b). Peristomatal transpiration and stomatal movement: A controversial view. III. Visible effects of peristomatal transpiration on the epidermis. Z. Pflanzenphysiol. 91, 225-238.
- Maier-Maercker, U. (1983). The role of peristomatal transpiration in the mechanism of stomatal movement. *Plant Cell Environ.* **6**, 369-380.
- Malik, R. S., Dhankar, J. S., and Turner, N. C. (1979). Influence of soil water deficits on root growth of cotton seedlings. *Plant & Soil* 53, 109-115.
- Malone, M. (1993). Hydraulic signals. Phil. Trans. Roy. Soc. London Ser. B 341, 33-39.
- Mancino, C. F., and Pepper, I. L. (1992). Irrigation of turfgrass with secondary sewage effluent: soil quality. *Agron. J.* 84, 650-654.
- Maness, N. O., and McBee, G. G. (1986). Role of placental sac in endosperm carbohydrate import in sorghum caryopses. *Crop Sci.* 26, 1201–1207.
- Mansfield, T. A. (1986). The physiology of stomata: New insights into old problems. *In* "Plant Physiology" (F. C. Steward, J. F. Sutcliffe, and J. E. Dale, eds.), Vol. 9, pp. 155–224. Academic Press, New York.
- Mansfield, T. A., Hetherington, A. M., and Atkinson, C. J. (1990). Some current aspects of stomatal physiology. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 41, 55-75.
- Mansfield, T. A., and Jones, R. J. (1971). Effects of abscisic acid on potassium uptake and starch content of stomatal guard cells. *Planta* 101, 147–158.
- Markhart, A. H., III, Fiscus, E. L., Naylor, A. W., and Kramer, P. J. (1979). Effect of temperature on water and ion transport in soybean and broccoli systems. *Plant Physiol.* 64, 83-87.
- Markhart, A. H., III, Peet, M. M., Sionit, N., and Kramer, P. J. (1980). Low temperature acclimation of root fatty acid composition, leaf water potential, gas exchange and growth of soybean seedlings. *Plant Cell Environ.* 3, 435–441.
- Marks, G. C., and Kozlowski, T. T., eds. (1973). "Ectomycorrhizae: Their Ecology and Physiology." Academic Press, New York.
- Marschner, H. (1986). "Mineral Nutrition of Higher Plants." Academic Press, New York.

- USA 87 Marshall, D. C. (1958). Measurement of sap flow in conifers by heat transport. Plant Physiol. 21, 95-101.
- oots of Martin, B., Bytnerowicz, A., and Thorstenson, Y. R. (1988). Effects of air pollutants on the composition of stable carbon isotopes, δ^{13} C, of leaves and wood, and on leaf injury. *Plant Physiol.* tion of 88, 218–223.

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s fer-

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3.

i

- Martin, B., Nienhuis, J., King, G., and Schaefer, A. (1989). Restriction fragment length polymorphisms associated with water use efficiency in tomato. *Science* 243, 1725-1728.
- Martin, B., and Thorstenson, Y. R. (1988). Stable carbon isotope composition (δ^{13} C), water use efficiency, and biomass productivity of Lycopersicon esculentum, Lycopersicon pennellii, and the F₁ hybrid. Plant Physiol. 88, 213–217
- Martin, C. E., and Schmitt, A. K. (1989). Unusual water relations in the CAM atmospheric epiphyte *Tillandsia usneoides* L. (Bromeliaceae). *Bot. Gaz.* 150, 1-8.
- Martin, C. K., Cassel, D. K., and Kamprath, E. J. (1979). Irrigation and tillage effects on soybean yields in a Coastal Plains soil. *Agron. J.* 71, 592-594.
- Martin, E. V., and Clements, F. E. (1935). Studies of the effect of artificial wind on growth and transpiration in *Helianthus annuus*. *Plant Physiol.* 10, 613-636.
- Maruyama, S., and Boyer, J. S. (1994). Auxin action on growth in intact plants: Threshold turgor is regulated. *Planta* 193, 44-50.
- Marvin, J. W. (1958). The physiology of maple sap flow. *In* "The Physiology of Forest Trees" (K. V. Thimann, ed.), pp. 95–124. The Ronald Press Company, New York.
- Marx, D. H. (1980). Growth of loblolly and shortleaf pine seedlings after years on a strip-mined coal spoil in Kentucky is stimulated by *Pisolithus* ectomycorrhizae and "starter" fertilizer pellets. Abstr. North Am. Conf. Mycorrhizae, 3rd, 1977.
- Marx, D. H., Cordell, C. E., Kenney, D. S., Mexal, J. G., Artman, J. D., Riffle, J. W., and Molina, R. J. (1984). Commercial vegetative inoculum of *Pisolithus tinctorius* and inoculation techniques for development of ectomycorrhizae on bare-root tree seedlings. For. Sci. Monogr. 25.
- Marx, D. H., Hedin, A., and Toe, P. S. (1985). Field performance of *Pinus caribaes*, var. hondurensis seedlings with specific ectomycorrhizae and fertilizer after 3 years on a savannah site in Liberia. For. Ecol. Manag. 13, 1-25.
- Masle, J., and Farquhar, G. D. (1988). Effects of soil strength on the relation of water-use efficiency and growth to carbon isotope discrimination in wheat seedlings. *Plant Physiol.* 86, 32–38
- Masle, J., and Passioura, J. B. (1987). Effects of soil strength on the growth of wheat seedlings. Aust. J. Plant Physiol. 14, 643-656.
- Mason, A. C. (1958). The effect of soil moisture on the mineral composition of apple plants grown in pots. J. Hort. Sci. 33, 202–211.
- Mason, H., S., Guerrero, F., D., Boyer, J. S., and Mullet, J. E. (1988b). Proteins homologous to leaf glycoproteins are abundant in stems of dark-grown soybean seedlings: Analysis of proteins and cDNAs. *Plant Mol. Biol.* 11, 845–856.
- Mason, H. S., and Matsuda, K. (1985). Polyribosome metabolism, growth and water status in the growing tissues of osmotically stressed plant seedlings. *Physiol. Plant.* **64**, 95–104.
- Mason, H. S., and Mullet, J. E. (1990). Expression of two soybean vegetative storage protein genes during development and in response to water deficit, wounding and jasmonic acid. *Plant Cell* 2, 569-579.
- Mason, H. S., Mullet, J. E., and Boyer, J. S. (1988a). Polysomes, messenger RNA and growth in soybean stems during development and water deficit. *Plant Physiol.* 86, 725-733.
- Masse, W. B. (1981). Prehistoric irrigation systems in the Salt River Valley, Arizona. Science 214, 408-415.
- Masuda, Y. (1985). Cell wall modifications during auxin-induced cell extension in monocotyledonous and dicotyledonous plants. *Biol. Plant. (Praha)* 27, 119–124.

- Materechera, S. A., Dexter, A. R., Alston, A. M., and Kirby, J. M. (1992). Growth of seedling roots in response to external osmotic stress by polyethylene glycol 20,000. *Plant Soil* 143, 85-91.
- Matthews, M. A., and Boyer, J. S. (1984). Acclimation of photosynthesis to low water potentials. *Plant Physiol.* 74, 161–166.
- Matthews, M. A., Van Volkenburgh, E., and Boyer, J. S. (1984). Acclimation of leaf growth to low water potentials in sunflower. *Plant Cell Environ.* 7, 199-206.
- Matyssek, R., Maruyama, S., and Boyer, J. S. (1991b). Growth-induced water potentials may mobilize internal water for growth. *Plant Cell Environ.* 14, 917-923.
- Matyssek, R., Maruyama, S., and Boyer, J. S. (1988). Rapid wall relaxation in elongating tissues. Plant Physiol. 86, 1163-1167.
- Matyssek, R., Tang, A.-C., and Boyer, J. S. (1991a). Plants can grow on internal water. *Plant Cell Environ.* 14, 925-930.
- Maugh, T. H., II (1978). Soviet science: A wonder water from Kazakhstan. Science 202, 414.
- Maurel, C., Reizer, J., Schroeder, J. I., and Chrispeels, M. J. (1993). The vacuolar membrane protein γ-TIP creates water specific channels in *Xenopus* oocytes. *EMBO J.* 12, 2241–2247.
- Mauro, A. (1965). Osmotic flow in a rigid porous membrane. Science 149, 867-869.
- Maximov, N. A. (1929). "The Plant in Relation to Water." English translation by R. H. Yapp. Allen and Unwin, London.
- Mayoral, M. L., Atsmon, D., Shimshi, D., and Gromet-Elhanan, Z. (1981). Effect of water stress on enzyme activities in wheat and related wild species: Carboxylase activity, electron transport, and photophosphorylation in isolated chloroplasts. *Aust. J. Plant Physiol.* 8, 385-393.
- McAinsh, M. R., Brownlee, C., and Hetherington, A. M. (1990). Abscisic acid-induced elevation of guard cell crytosolic Ca²⁺ precedes stomatal closure. *Nature* (London) 343, 186–188.
- McArthur, D. A. J., and Knowles, N. R. (1992). Resistance responses of potato to vesicular-arbuscular mycorrhizal fungi under varying abiotic phosphorus levels. *Plant Physiol.* 100, 341-351.
- McCain, D. C., Croxdale, J., and Markley, J. L. (1988). Water is allocated differently to chloroplasts in sun and shade leaves. *Plant Physiol.* 86, 16–18.
- McCauley, G. N. (1993). Nonionic surfactant and supplemental irrigation of soybean on crusting soils. Agron. J. 85, 17-21.
- McComb, A. L., and Loomis, W. E. (1944). Subclimax prairie. *Torrey Bot. Club Bull.* 71, 46-76. McCree, K. J. (1974). Changes in stomatal response characteristics of grain sorghum produced by water stress during growth. *Crop Sci.* 14, 273-278.
- McCully, M. E., and Canny, M. J. (1988). Pathways and processes of water and nutrient movement in roots. *Plant Soil* 111, 159-170.

- McDermott, J. J. (1941). The effect of the method of cutting on the moisture content of samples from tree branches. Am. J. Bot. 28, 506-508.
- McDermott, J. J. (1945). The effect of the moisture content of the soil upon the rate of exudation. *Am. J. Bot.* 32, 570-574.
- McIntyre, G. I. (1987). The role of water in the regulation of plant development. Can. J. Bot. 65, 1287-1298.
- McIntyre, G. I., and Boyer, J. S. (1984). The effect of humidity, root excision, and potassium supply on hypocotyl elongation in dark-grown seedlings of *Helianthus annuus*. Can. J. Bot. 62, 420–428.
- McKenney, M. S., and Rosenberg, N. J. (1993). Sensitivity of some potential evapotranspiration estimation methods to climate change. *Agric. For. Meteorol.* **64**, 81–110.
- McMichael, B. L., and Persson, H. (eds.) (1991). "Plant Roots and Their Environment." Elsevier, Amsterdam.
- McNaughton, K. G., and Jarvis, P. G. (1983). Predicting effects of vegetation changes on transpiration and evaporation. *In* "Water Deficits and Plant Growth" (T. T. Kozlowski, ed.), Vol. 7, pp. 1–47. Academic Press, New York.

- McNeil, D. I. (1976). The basis of osmotic pressure maintenance during expansion growth in *Helianthus annuus* hypocotyls. *Aust. J. Plant Physiol.* 3, 311-324.
- McPherson, H. G., and Boyer, J. S. (1977). Regulation of grain yield by photosynthesis in maize subjected to a water deficiency. *Agron. J.* 69, 714-718.
- McWilliam, J. R., and Kramer, P. J. (1968). The nature of the perennial response in Mediterranean grasses. I. Water relations and summer survival in *Phalaris*. Aust. J. Agric. Res. 19, 381-395.
- McWilliam, J. R., Kramer, P. J., and Musser, R. L. (1982). Temperature-induced water stress in chilling-sensitive plants. *Aust. J. Plant Physiol.* 9, 343–352.
- Mederski, H. J., and Jeffers, D. L. (1973). Yield response of soybean varieties grown at two soil moisture stress levels. Agron. J. 65, 410-412.
- Meidner, H. (1975). Water supply, evaporation, and vapour diffusion in leaves. J. Exp. Bot. 26, 666-673.
- Meidner, H. (1976a). Vapour loss through stomatal pores with the mesophyll tissue excluded. J. Exp. Bot. 27, 172-174.
- Meidner, H. (1976b). Water vapour loss from a physical model of a substomatal cavity. J. Exp. Bot. 27, 691-694.
- Meidner, H. (1986). Historical sketches 13. J. Exp. Bot. 37, 135-137.
- Meidner, H. (1990). The absorption lag, epidermal turgor and stomata. J. Exp. Bot. 41, 1115-1118.
- Meidner, H. (1992). Developments in mass flow porometry. J. Exp. Bot. 43, 1309-1314.
- Meidner, H., and Mansfield, T. A. (1968). "Physiology of Stomata." McGraw-Hill, London.
- Meinzer, F. C., and Grantz, D. A. (1991). Coordination of stomatal, hydraulic, and canopy boundary layer properties: Do stomata balance conductances by measuring transpiration? *Physiol. Plant.* 83, 324–329.
- Meinzer, F. C., Grantz, D. A., and Smit, B. (1991). Root signals mediate coordination of stomatal and hydraulic conductance in growing sugarcane. *Aust. J. Plant Physiol.* 19, 329–338.
- Meisner, C. A., and Karnok, K. J. (1991). Root hair occurrence and variation with environment. Agron. J. 83, 814-818.
- Melchior, W., and Steudle, E. (1993). Water transport in onion (Allium cepa L.) roots. Plant Physiol. 101, 1305-1315.
- Mendelssohn, I. A., McKee, K. L., and Patrick, W. H., Jr. (1981). Oxygen deficiency in *Spartina alterniflora* roots: Metabolic adaptation to anoxia. *Science* 214, 439-441.
- Mendelssohn, I. A., and Postek, M. T. (1982). Elemental analysis of deposits on the roots of Spartina alterniflora Loieal. Am. J. Bot. 69, 904-912.
- Mengel, D. B., and Barber, S. A. (1974). Development and distribution of the corn root system under field conditions. *Agron. J.* 66, 341–344.
- Merkle, F. G., and Dunkle, E. C. (1944). Soluble salt content of greenhouse soils as a diagnostic aid. Am. Soc. Agron. J. 36, 10-19.
- Merwin, H. E., and Lyon, H. (1909). Sap pressure in the birch stem. Bot. Gaz. 48, 442-458.
- Meshcheryakov, A., Steudle, E., and Komor, E. (1992). Gradients of turgor, osmotic pressure, and water potential in the cortex of the hypocotyl of growing *Ricinus* seedlings. *Plant Physiol.* 98, 840–852.
- Métraux, J.-P. (1982). Changes in cell-wall polysaccharide composition of developing *Nitella* internodes. *Planta* 155, 459–466.
- Meyer, B. S. (1932). The daily periodicity of transpiration in the tulip poplar, Liriodendron tulipifera L. Ohio J. Sci. 32, 104-114.
- Meyer, B. S. (1938). The water relations of plant cells. Bot. Rev. 4, 531-547.
- Meyer, B S. (1945). A critical evaluation of the terminology of diffusion phenomena. *Plant Physiol.* 20, 142–164.
- Meyer, B. S., and Anderson, D. B. (1952) "Plant Physiology." 2nd Ed. D. Van Nostrand & Co., New York.

- Meyer, B. S., Anderson, D. B., Bohning, R. H., and Fratianne, D. G. (1973). "Introduction to Plant Physiology." D. Van Nostrand & Co., New York.
- Meyer, R. F., and Boyer, J.S. (1972). Sensitivity of cell division and cell elongation to low water potentials in soybean hypocotyls. *Planta* 108, 77–87.
- Meyer, R. F., and Boyer, J. S. (1981). Osmoregulation, solute distribution, and growth in soybean seedlings having low water potentials. *Planta* 151, 482–489.
- Meyer, W. S., and Alston, A. M. (1978). Wheat responses to seminal geometry and subsoil water. Agron. J. 70, 981-986.
- Meyer, W. S., and Ritchie, J. T. (1980). Water status of cotton as related to taproot length. *Agron. J.* 72, 577-580.
- Michailides, T. J., Morgan, D. P., Grant, J. A., and Olson, W. H. (1992). Shorter sprinkler irrigations reduce *Botryosphaeria* blight of pistachio. *Calif. Agric.* 48, 28-32.
- Michelena, V. A., and Boyer, J. S. (1982). Complete turgor maintenance at low water potentials in the elongating region of maize leaves. *Plant Physiol.* 69, 1145-1149.
- Micke, W. C., Yeager, J. T., Vosson, P. M., Bethell, R. S., Foott, J. H., and Tyler, R. H. (1992). Apple rootstocks evaluated in California. *Calif. Agr.* 46, 23–25.
- Milburn, J. A., and Johnson, R. P. C. (1966). The conduction of sap. II. Detection of vibrations produced by sap cavitation in *Ricinus* xylem. *Planta* 69, 43-52.
- Milburn, J. A., Kallarackal, J., and Baker, D. A. (1990). Water relations of the banana. I. Predicting the water relations of the field-grown banana using the exuding latex. *Aust. J. Plant Physiol.* 17, 57-68.
- Milburn, J. A., and Zimmermann, M. H. (1977). Preliminary studies on sapflow in Cocos nucifera L. II. Phloem transport. New Phytol. 79, 543-558.
- Millard, P., and Chudek, J. A. (1993). Imaging the vascular continuity of *Prunus avium* during leaf senescence using nuclear magnetic resonance spectroscopy. *J. Exp. Bot.* 44, 599-603.
- Miller, D. E., and Hang, A. N. (1980). Deficit, high-frequency irrigation of sugar beets with the line source technique. *Soil Sci. Soc. Am. I.* 44, 1295–1298.
- Miller, D. M. (1985). Studies of root function in Zea mays. III. Xylem sap composition at maximum root pressure provides evidence of active transport into the xylem and a measurement of the reflection coefficient of the root. *Plant Physiol.* 77, 162–167.
- Miller, E. C. (1938). "Plant Physiology," 2nd Ed. McGraw-Hill, New York.
- Miller, E. C., and Saunders, A. R. (1923). Some observations on the temperature of the leaves of crop plants. J. Agric. Res. 26, 15-43.
- Miller, E. E., and Salehzadeh, A. (1993). Stripper for bubble-free tensiometry. J. Soil Sci. Soc. Am. 57, 1470-1473.
- Milligan, S. P., and Dale, J. E. (1988a). The effects of root treatments on growth of the primary leaves of *Phaseolus vulgaris* L.: General features. *New Phytol.* 108, 27-35.
- Milligan, S. P., and Dale, J. E. (1988b). The effects of root treatments on growth of the primary leaves of *Phaseolus vulgaris* L.: Biophysical analysis. *New Phytol.* 109, 35-40.
- Minshall, W. H. (1964). Effect of nitrogen-containing nutrients on exudation from detopped tomato plants. *Nature (London)* 202, 925-926.
- Minshall, W. H. (1968). Effects of nitrogenous materials on translocation and stump exudation in root systems of tomato. Can. J. Bot. 46, 363-376.
- Mittelheuser, C. J., and Van Steveninck, R. F. M. (1969) Stomatal closure and inhibition of transpiration induced by (RS)-abscisic acid. *Nature* (London) 221, 281–282.
- Mohanty, P., and Boyer, J. S. (1976). Chloroplast response to low leaf water potentials. IV. Quantum yield is reduced. *Plant Physiol.* 57, 704–709.
- Moinat, A. D. (1943). An auto-irrigator for growing plants in the laboratory. *Plant Physiol.* 18, 280-287.
- Molisch, H. (1912). Das Offen- und Geschlossensein der Spaltöffnungen, veranschaulicht durch eine neue Methode (Infiltrations-methode). Z. Bot. 4, 106-122.

- Molz, F. J., and Boyer, J. S. (1978). Growth-induced water potentials in plant cells and tissues. Plant Physiol. 62, 423–429.
- Molz, F. J., and Ferrier, J. M. (1982). Mathematical treatment of water movement in plant cells and tissues: a review. *Plant Cell Environ.* 5, 191–206.
- Molz, F. J., and Hornberger, G. M. (1973). Water transport through plant tissues in the presence of a diffusable solute. Soil Sci. Soc. Am. Proc. 37, 833-837.
- Molz, F. J., and Ikenberry, E. (1974). Water transport through plant cells and cell walls: Theoretical development. Soil Sci. Soc. Am. Proc. 38, 699–704.
- Molz, F. J., Kerns, D. V., Jr., Peterson, C. M., and Dane, J. H. (1979). A circuit analog model for studying quantitative water relations of plant tissue. *Plant Physiol.* 64, 712–716.
- Monteith, J. L. (1963). Dew: Facts and fallacies. *In* "The Water Relations of Plants" (A. J. Rutter and F. H. Whitehead, eds...), pp. 37-56. Wiley, New York.
- Monteith, J. L. (1965). Evaporation and environment. Symp. Soc. Exp. Biol. 19, 205-234.
- Monteith, J. L., and Owen, P. C. (1958). A thermocouple method for measuring relative humidity in the range 95-100%. J. Sci. Instrum. 35, 443-446.
- Montfort, C. (1922). Die Wasserbilanz in N\u00e4hrl\u00f6ssung, Salzl\u00f6ssung, und Hochmoorwasser. Zeitschrf. Bot 14, 98-172.
- Mooney, H. A., Gulmon, S. L., Rundel, P. W., and Ehleringer, J. (1980). Further observations on the water relations of *Prosopis tamarugo* of the northern Atacama desert. *Oecologia* (Berlin) 44, 177–180.
- Moreland, D. E. (1950). A study of translocation of radioactive phosphorous in loblolly pine (*Pinus taeda* L.). Elisha Mitchell Sci. Soc. J. 66, 175–181.
- Morgan, J. M. (1980). Possible role of abscisic acid in reducing seed set in water-stressed wheat plants. *Nature* 285, 655-657.
- Morgan, J. M. (1983). Osmoregulation as a selection criterion for drought tolerance in wheat. Aust. J. Agric. Res. 34, 607-614.
- Morgan, J. M. (1984). Osmoregulation and water stress in higher plants. Annu. Rev. Plant Physiol. 35, 299-319.
- Morikawa, Y., Hattori, S., and Kiyono, Y. (1986). Transpiration of a 31-year-old Chamaecyparis obtusa Endl. stand before and after thinning. Tree Physiol. 2, 105-114.
- Morilla, C. A., Boyer, J. S., and Hageman, R. H. (1973). Nitrate reductase activity and polyribosomal content of corn (*Zea mays L.*) seedlings having low leaf water potentials. *Plant Physiol.* 51, 817–824.
- Morrison, J. C., Greve, L. C., and Richmond, P. A. (1993). Cell wall synthesis during growth and maturation of *Nitella* internodal cells. *Planta* 189, 321–328.
- Moss, D. N., and Rawlins, S. L. (1963). Concentration of carbon dioxide inside leaves. *Nature* (London) 197, 1320-1321.
- Moss, G. I., and Downey, L. A. (1971). Influence of drought stress on female gametophyte development in corn (Zea mays L.) and subsequent grain yield. Crop Sci. 11, 368–372.
- Mott, K. A. (1988). Do stomata respond to CO₂ concentrations other than intercellular? *Plant Physiol.* 86, 200–203.
- Mott, K. A., and Parkhurst, D. F. (1991). Stomatal responses to humidity in air and helox. *Plant Cell Environ.* 14, 509-515.
- Mozhaeva, L. V., and Pilschshikova, N. V. (1979). The motive force behind bleeding of plants. Soviet Plant Physiol. 26, 802-807.
- Muchow, R. C., and Sinclair, T. R. (1989). Epidermal conductance, stomatal density and stomatal size among genotypes of *Sorghum bicolor* (L.) Moench. *Plant Cell Environ.* 12, 425-431.
- Mudd, J. B., and Kozlowski, T. T., eds. (1975). "Responses of Plants to Air Pollution." Academic Press, New York.
- Mujer, C. V., Rumpho, M. E., Lin, J.-J., and Kennedy, R. A. (1993). Constitutive and inducible

- aerobic and anaerobic stress proteins in the *Echinochloa* complex and rice. *Plant Physiol.* 101, 217–226.
- Muller, C. H. (1969). Allelopathy as a factor in ecological process. Vegetation 18, 348-357.
- Mundy, J., and Chua, N.-H. (1988). Abscisic acid and water-stress induce the expression of a novel rice gene. *EMBO J.* 7, 2279–2286.
- Munns, R. (1988). Why measure osmotic adjustment? Aust. J. Plant Physiol. 15, 717-726.
- Munns, R. (1990). Chemical signals moving from roots to shoots: the case against ABA. In "Importance of Root to Shoot Communication in the Response to Environmental Stress" (W. J. Davies and B. Jeffcoat, eds.), pp. 175–183. Monogr. 21. British Soc. Plant Growth Regulation, Bristol, U.K.
- Munns, R. (1993). Physiological processes limiting plant growth in saline soils: Some dogmas and hypotheses. *Plant Cell Environ.* 16, 15–24.
- Munns, R., Brady, C. J., and Barlow, E. W. R. (1979). Solute accumulation in the apex and leaves of wheat during water stress. Aust. J. Plant Physiol. 6, 379-389.
- Munns, R., and King, R. W. (1988). Abscisic acid is not the only stomatal inhibitor in the transpiration stream of wheat plants. *Plant Physiol.* 88, 703-708.
- Munns, R., and Pearson, C. J. (1974). Effect of water deficit on translocation of carbohydrate in *Solanum tuberosum*. Aust. J. Plant Physiol. 1, 529-537.
- Munns, R., and Termaat, A. (1986). Whole plant responses to salinity. Aust. J. Plant Physiol. 13, 143-160.
- Munns, R., and Weir, R. (1981). Contribution of sugars to osmotic adjustment in elongating and expanded zones of wheat leaves during moderate water deficits at two light levels. *Aust. J. Plant Physiol.* 8, 93-105.
- Murphy, R., and Smith, J. A. C. (1994). A critical comparison of the pressure-probe and pressure-chamber techniques for estimating leaf cell turgor pressure in *Kalanchoe daigremontiana*. *Plant Cell Environ*. 17, 15-29.
- Musser, R. L., Thomas, S. A., and Kramer, P. J. (1983). Short and long term effects of root and shoot chilling of Ransom soybean. *Plant Physiol.* 73, 778-783.
- Mustafa, M. A., and Letey, J. (1970). Factors affecting effectiveness of two surfactants on water-repellent soils. *Calif. Agr.* 24, 12–13.
- Myers, B. A., Kuppers, M., and Neales, T. F. (1987). Effect of stem excision under water on bulk leaf water potential, leaf conductance, CO₂ assimilation and stemwood water storage in *Eucolyptus behriana* F. Muell. Aust. J. Plant Physiol. 14, 135–145.
- Myers, P. N., Setter, T. L., Madison, J. T., and Thompson, J. F. (1990). Abscisic acid inhibition of endosperm cell division in cultured maize kernels. *Plant Physiol.* **94**, 1330–1336.
- Neales, T. F., Patterson, A. A., and Hartney, V. J. (1968). Physiological adaptation to drought in the carbon assimilation and water loss of xerophytes. *Nature* (London) 219, 469-472.
- Neher, H. V. (1993). Effects of pressures inside Monterey pine trees. Trees 8, 9-17.
- Neill, S. J., and Horgan, R. (1985). Abscisic acid production and water relations in wilty tomato mutants subjected to water deficiency. J. Exp. Bot. 36, 1222–1231.
- Néméthy, G., and Scheraga, H. A. (1962). Structure of water and hydrophobic bonding in proteins. I. A model for the thermodynamic properties of liquid water. I. Chem. Physics 36, 3382-3400.
- Newman, E. I. (1966). Relationship between root growth of flax (*Linum usitatissimum*) and soil water potential. *New Phytol.* 65, 273–283.
- Newman, E. I. (1969). Resistance to water flow in soil and plant. I. Soil resistance in relation to amounts of root: Theoretical estimates. J. appl. Ecol. 6, 1-12.
- Newman, E. I. (1973). Permeability to water of the roots of five herbaceous species. *New Phytol.* 72, 547–555.
- Newman, E. I. (1974). Root-soil water relations. *In* "The Plant Root and its Environment" (E. W. Carson, ed.), pp. 363–440. University Press of Virginia, Charlottesville, VA.

- Newman, E. I. (1976). Water movement through root systems. *Phil. Trans. R. Soc. London Ser. B* 273, 463-478.
- Newman, E. I., and Andrews, R. T. (1973). Uptake of phosphorus and potassium in relation to root growth and root density. *Plant Soil* 38, 49-69.
- Nir, I., Klein, S., and Poljakoff-Mayber, A. (1969). Effect of moisture stress on submicroscopic structure of maize roots. Aust. J. Biol. Sci. 22, 17-33.
- Nishiyama, I. (1975). A break on the Arrhenius plot of germination activity in rice seeds. *Plant Cell Physiol.* 16, 535-536.
- Nnyamah, J. U., and Black, T. A. (1977). Rates and patterns of water uptake in a Douglas fir forest. Soil Sci. Soc. Am. J. 41, 972-979.
- Nnyamah, J. U., Black, T. A., and Tan, C. S. (1978). Resistance to water uptake in a Douglas fir forest. Soil Sci. 126, 63-76.
- Nobel, P. S. (1974). "Biophysical Plant Physiology." W. H. Freeman, San Francisco, CA.
- Nobel, P. S. (1983). "Biophysical Plant Physiology and Ecology." W. H. Freeman and Company, New York.
- Nobel, P. S. (1991). "Physicochemical and Environmental Plant Physiology." Academic Press, London.
- Nobel, P. S., and Cui, M. (1992). Hydraulic conductances of the soil, the root-soil air gap, and the root: changes for desert succulents in drying soil. J. Exp. Bot. 43, 319-326.
- Nobel, P. S., Miller, P. M., and Graham, E. A. (1992). Influence of rocks on soil temperature, soil water potential, and rooting patterns of desert succulents. *Oecologia* 92, 90–96.
- Nonami, H., and Boyer, J. S. (1987). Origin of growth-induced water potential: Solute concentration is low in apoplast of enlarging tissues. *Plant Physiol.* 83, 596–601.
- Nonami, H., and Boyer, J. S. (1989). Turgor and growth at low water potentials. *Plant Physiol.* 89, 798-804.
- Nonami, H., and Boyer, J. S. (1990a). Primary events regulating stem growth at low water potentials. *Plant Physiol.* **93**, 1601–1609.
- Nonami, H., and Boyer, J. S. (1990b). Wall extensibility and cell hydraulic conductivity decrease in enlarging stem tissues at low water potentials. *Plant Physiol.* 93, 1610–1619.
- Nonami, H., and Boyer, J. S. (1993). Direct demonstration of a growth-induced water potential gradient. *Plant Physiol.* **102**, 13-19.
- Nonami, H., and Schulze, E.-D. (1989). Cell water potential, osmotic potential, and turgor in the epidermis and mesophyll of transpiring leaves: Combined measurements with the cell pressure probe and nanoliter osmometer. *Planta* 177, 35–46.
- Nonami, H., Boyer, J. S., and Steudle, E. S. (1987). Pressure probe and isopiestic psychrometer measure similar turgor. *Plant Physiol.* 83, 592-595.
- Nonami, H., Schulze, E.-D., and Ziegler, H. (1991). Mechanisms of stomatal movement in response to air humidity, irradiance and xylem water potential. *Planta* 183, 57-64.
- Norberg, P., and Liljenberg, C. (1991). Lipids of plasma membranes prepared from oat root cells. Plant Physiol. 96, 1136-1141.
- Norby, R. J. (1987). Nodulation and nitrogenase activity in nitrogen-fixing woody plants stimulated by CO₂ enrichment of the atmosphere. *Physiol. Plant.* 41, 77–82.
- Norby, R. J., and Kozlowski, T. T. (1980). Allelopathic potential of ground cover species on *Pinus resinosa* seedlings. *Plant Soil* 57, 363-374.
- Norris, J. R., Read, D., and Varma, A. K. (1994). "Techniques for Mycorrhizal Research." Academic Press, San Diego.
- Norris, R. F., and Bukovac, M. J. (1968). Structure of the pear leaf cuticle with special reference to cuticular penetration. Am. J. Bot. 55, 975-983.
- North, G. B., and Nobel, P. S. (1991). Changes in hydraulic conductivity and anatomy caused by drying and rewetting roots of *Agave deserti* (Agavaceae). *Am. J. Bot.* 78, 906-915.

- Nutman, F. J. (1933). The root-system of *Coffea arabica*. II. The effect of some soil conditions in modifying the "normal" root-system. *Emp. J. Exp. Agric.* 1, 285–296.
- Nutman, F. J. (1934). The root system of Coffee arabica. III. The spatial distribution of the absorbing area of the root. Emp. J. Exp. Agric. 2, 293-302.
- Nutman, F. J. (1941). Studies of the physiology of Coffea arabica. III. Transpiration rates of whole trees in relation to natural environmental conditions. Ann. Bot. 5, 59–82.
- Nye, P. H., and Tinker, P. B. (1977). "Solute Movement in the Soil-Root system." University of California Press, Berkeley, CA.
- Oades, J. M. (1978). Mucilages at the root surface. J. Soil Sci. 29, 1-16.
- Oaks, A. (1992). A re-evaluation of nitrogen assimilation in roots. Bioscience 42, 103-111.
- Oertli, J. J. (1966). Active water transport in plants. Physiol. Plant. 19, 809-817.
- Ogawa, T., Grantz, D., Boyer, J. S., and Govindjee. (1982). Effects of cations and abscisic acid on chlorophyll a fluorescence in guard cells of *Vicia faba*. Plant Physiol. 69, 1140–1144.
- Ogawa, T., Ishikawa, H., Shimada, K., and Shibata, K. (1978). Synergistic action of red and blue light and action spectra for malate formation in guard cells of *Vicia faba* L. *Planta* 142, 61–65.
- Ögren, E., and Öquist, G. (1985). Effects of drought on photosynthesis, chlorophyll fluorescence and photoinhibition susceptibility in intact willow leaves. *Planta* 166, 380–388.
- Oke, T. R. (1987). "Boundary Layer Climates," 2nd Ed. Methuen, London.
- O'Leary, J. W. (1969). The effect of salinity on permeability of roots to water. Israel J. Bot. 18, 1-9.
- O'Leary, J. W., and Knecht, G. W. (1971). The effect of relative humidity on growth, yield and water consumption of bean plants. J. Am. Soc. Hort. Sci. 96, 263-265.
- O'Leary, J. W., and Kramer, P. J. (1964). Root pressure in conifers. Science 145, 284-285.
- O'Leary, J. W., and Prisco, J. T. (1970). Response of osmotically stressed plants to growth regulators. Adv. Front. Plant Sci. 25, 129-139.
- Olesen, P., and Robards, A. W. (1990). The neck region of plasmodesmata: General architecture and some functional aspects. *In* "Parallels in Cell to Cell Junctions in Plants and Animals" (A. W. Robards, W. J. Lucas, J. D. Pitts, H. J. Jongsma, and D. C. Spray, eds.), pp. 145-170. Cell to Cell Signals in Plants and Animals, NATO Advanced Research Workshop, Springer-Verlag, Heidelberg, Germany.
- Oliver, M. J. (1991). Influence of protoplasmic water loss on the control of protein synthesis in the desiccation-tolerant moss *Tortula ruralis*. *Plant Physiol.* 97, 1501–1511.
- Olszyk, D. M., and Tingey, D. T. (1986). Joint action of O₃ and SO₂ in modifying plant gas exchange. *Plant Physiol.* 82, 401–405.
- Omasa, K., Hashimoto, Y., Kramer, P. J., Strain, B. R., Aiga, I., and Kondo, J. (1985a). Direct observation of reversible and irreversible stomatal responses of attached sunflower leaves to SO₂. *Plant Physiol.* 79, 153–158.
- Omasa, K., Onoe, M., and Yamada, H. (1985b). NMR imaging for measuring root systems and soil water content. *Environ. Control Biol.* 23, 99-102.
- O'Neill, E. G., Luxmoore, R. J., and Norby, R. J. (1987). Increases in mycorrhizal colonization and seedling growth in *Pinus echinata* and *Quercus alba* in an enriched CO₂ atmosphere. *Can. J. For. Res.* 17, 878-883.
- Oosterhuis, D. M., Walker, S., and Eastham, J. (1985). Soybean leaflet movements as an indicator of crop water stress. *Crop Sci.* 25, 1101–1106.
- Oosting, H. J. (1956). "The Study of Plant Communities," 2nd Ed. W. H. Freeman, San Francisco, CA.
- Oppenheimer, H. R. (1941). Root cushions, root stalagmites and similar structures. *Palestine J. Bot. Ser.* 4, 11–19.
- Orchard, P. W., and Jessop, R. S. (1984). The response of sorghum and sunflower to short-term waterlogging. I. Effects of stage of development and duration of waterlogging on growth and yield. *Plant Soil* 81, 119-132.

- Ordin, L., and Kramer, P. J. (1956). Permeability of Vicia faba root segments to water as measured by diffusion of deuterium hydroxide. *Plant Physiol.* 31, 468–471.
- Orians, G. H., and Solbrig, O. T. (1977). A cost-income model of leaves and roots with special reference to arid and semi-arid areas. Am. Nat. 111, 677-690.
- Ort, D. R., and Boyer, J. S. (1985). Plant productivity, photosynthesis and environmental stress. *In* "Changes in Eukaryotic Gene Expression in Response to Environmental Stress" (B. G. Atkinson and D. B. Walden, eds.), pp. 279-313. Academic Press, New York.
- Ortega, J. K. E., Zehr, E. G., and Keanini, R. G. (1989). In vivo creep and stress relaxation experiments to determine the wall extensibility and yield threshold for the sporangiophores of *Phycomyces. Biophys. J.* 56, 465-475.
- Ortiz-Lopez, A., Ort, D. R., and Boyer, J. S. (1991). Photophosphorylation in attached leaves of *Helianthus annuus* at low water potentials. *Plant Physiol.* 96, 1018-1025.
- Oskamp, J., and Batjer, L. P. (1932). Soils in relation to fruit growing in New York. II. Size, production, and rooting habit of apple trees on different soil types in the Hilton and Morton Areas, Monroe County. Cornell Univ. Agr. Exp. Sta. Bull. 550.
- Osmond, C. B. (1978). Crassulacean acid metabolism: A curiosity in context. Annu. Rev. Plant Physiol. 29, 379-414.
- Osmond, D. L., Wilson, R. F., and Raper, C. D., Jr. (1982). Fatty acid composition and nitrate uptake of soybean roots during acclimation to low temperature. *Plant Physiol.* 70, 1689–1693.
- Osonubi, O., Oren, R., Werk, K. S., Schulze, E.-D., and Heilmeier, H. (1988). Performance of two *Picea abies* (L.) Karst.. stands at different stages of decline. IV. Xylem sap concentrations of magnesium, calcium, potassium, and nitrogen. *Oecologia* 77, 1-6.
- O'Toole, J. C. (1982). Adaptation of rice to drought-prone environments. *In* "Drought Resistance in Crops with Emphasis on Rice," pp. 195–213. International Rice Research Institute, Manila, Philippines.
- O'Toole, J. C., and Baldia, E. P. (1982). Water deficits and mineral uptake in rice. Crop Sci. 22, 1144-1150.
- O'Toole, J. C., and Bland, W. L. (1987). Genotypic variation in crop plant root systems. Adv. Agron. 41, 91–145.
- O'Toole, J. C., Crookston, R. K., Treharne, K. J., and Ozbun, J. L. (1976). Mesophyll resistance and carboxylase activity. *Plant Physiol.* 57, 465-468.
- O'Toole, J. C., and Cruz, R. T. (1980). Response of leaf water potential, stomatal resistance and leaf rolling to water stress. *Plant Physiol.* 63, 428-437.
- O'Toole, J. C., Hsiao, T. C., and Namuco, O. S. (1984). Panicle water relations during water stress. *Plant Sci. Lett.* 33, 137–143.
- Oussible, M., Crookston, R. K., and Larson, W. E. (1992). Subsurface compaction reduces the root and shoot growth and grain yield of wheat. *Agron. J.* 84, 34–38.
- Outlaw, W. H., Jr. (1989). Critical examination of the quantitative evidence for and against photosynthetic CO₂ fixation by guard cells. *Physiol. Plant.* 77, 275-281.
- Outlaw, W. H., Jr., and Manchester, J. (1979). Guard cell starch concentration quantitatively related to stomatal aperture. *Plant Physiol.* 64, 79–82.
- Outlaw, W. H., Jr., Mayne, B. C., Zenger, V. E., and Manchester, J. (1981). Presence of both photosystems in guard cells of *Vicia faba* L. Implications for environmental signal processing. *Plant Physiol.* 67, 12-16.
- Owen, P. C. (1952). The relation of germination of wheat to water potential. J. Exp. Bot. 3, 188-203.
- Owston, P. W., Smith, J. L., and Halverson, H. F. (1972). Seasonal water movement in tree stems. For. Sci. 18, 266-272.
- Pallardy, S. G., and Kozlowski, T. T. (1979). Stomatal response of *Populus* clones to leaf water potential and environment. *Oecologia* 40, 371–380.

- Pallardy, S. G., and Kozlowski, T. T. (1980). Cuticle development in the stomatal region of *Populus* clones. *New Phytol.* 85, 363–365.
- Palzkill, D. A., and Tibbits, T. W. (1977). Evidence that root pressure flow is required for calcium transport to head leaves of cabbage. *Plant Physiol.* 60, 854–856.
- Pandey, R. K., Herrera, W. A. T., and Pendleton, J. W. (1984a). Drought response of grain legumes under irrigation gradient. I. Yield and yield components. Agron. J. 76, 549-553.
- Pandey, R. K., Herrera, W. A. T., Villegas, A. N., and Pendleton, J. W. (1984b). Drought response of grain legumes under irrigation gradient. III. Plant growth. Agron. J. 76, 557-560.
- Pankhurst, C. E., and Sprent, J. I. (1975). Effects of water stress on the respiratory and nitrogenfixing activity of soybean root nodules. J. Exp. Bot. 26, 287-304.
- Pankhurst, C. E., and Sprent, J. I. (1976). Effects of temperature and oxygen tension on the nitrogenase and respiratory activities of turgid and water-stressed soybean and French bean root nodules. J. Exp. Bot. 27, 1–9.
- Paolillo, D. J., Jr. (1989). Cell and axis elongation in etiolated soybean seedlings are altered by moisture stress. Bot. Gaz. 150, 101-107.
- Pararajasingham, S., and Knievel, D. P. (1990). Nitrogenase activity, photosynthesis and total nonstructural carbohydrates in cowpea during and after drought stress. *Can. J. Plant Sci.* 70, 1005– 1012.
- Parker, J. (1949). Effects of variation in the root-leaf ratio on transpiration rate. *Plant Physiol.* 24, 739-743.
- Parker, J. (1950). The effects of flooding on the transpiration and survival of some southeastern forest tree species. *Plant Physiol.* 25, 453-460.
- Parkhurst, D. F. (1978). The adaptive significance of stomatal occurrence on one or both surfaces of leaves. J. Ecol. 66, 367-383.
- Parkhurst, D. F., and Loucks, O. L. (1972). Optimal leaf size in relation to environment. J. Ecol. 60, 505-537.
- Parrish, J. T. (1983). Paleozoic atmospheric circulation and oceanic upwelling. In "Paleoclimate and Mineral Deposits" (T. M. Cronin, W. F. Cannon, and R. Z. Poore, eds.), pp. 37–39. U.S. Geological Survey, Alexandria, VA.
- Parsons, L. R., Combs, B. S., and Tucker, D. P. H. (1985). Citrus freeze protection with microsprinkler irrigation during an advective freeze. Hort. Sci. 20, 1078-1080.
- Parsons, L. R., and Kramer, P. J. (1974). Diurnal cycling in root resistance to water movement. *Physiol Plant.* 30, 19-23.
- Parsons, L. R., Wheaton, T. A., Faryna, N. D., and Jackson, J. L. (1991). Elevated microsprinklers improve protection of citrus trees in an advective freeze. *Hort. Sci.* 26, 1149–1151.
- Passioura, J. B. (1972). The effect of root geometry on the yield of wheat growing on stored water. Aust. J. Agric. Res. 23, 745-752.
- Passioura, J. B. (1980a). The transport of water from soil to shoot in wheat seedlings. J. Exp. Bot. 31, 333-345.
- Passioura, J. B. (1980b). The meaning of matric potential. J. Exp. Bot. 31, 1161-1169.
- Passioura, J. B. (1982). Water in the soil-plant-atmosphere continuum. In "Encyclopedia of Plant Physiology" (O. L. Lange, P. S. Nobel, C. B. Osmond, and H. Ziegler, eds.), Vol. 12B, pp. 5–33. Springer-Verlag, New York.
- Passioura, J. B. (1988a). Root signals control leaf expansion in wheat seedlings growing in drying soil. Aust. J. Plant Physiol. 15, 687-693.
- Passioura, J. B. (1988b). Water transport in and to roots. Annu. Rev. Plant Physiol. Plant Mol. Biol. 39, 245-265.
- Passioura, J. B. (1991). An impasse in plant water relations? Bot. Acta 104, 405-411.
- Passioura, J. B., and Tanner, C. B. (1985). Oscillations in apparent hydraulic conductance of cotton plants. Aust. J. Plant Physiol. 12, 445-461.

- Pate, J. S., Layzell, D. B., and Atkins, C. A. (1979). Economy of carbon and nitrogen in a nodulated and nonnodulated (NO₃-grown) legume. *Plant Physiol.* 64, 1083–1088.
- Patric, J. H., Douglass, J. E., and Hewlett, J. D. (1965). Soil water absorption by mountain and Piedmont forests. Soil Sci. Soc. Am. Proc. 29, 303-308.
- Patterson, D. T., Bunce, J. A., Alberte, R. S., and Van Volkenburgh, E. (1977). Photosynthesis in relation to leaf characteristics of cotton from controlled and field environments. *Plant Physiol.* 59, 384–387.
- Pavlychenko, T. K. (1937). Quantitative study of the entire root system of weed and crop plants under field conditions. *Ecology* 18, 62–79.
- Pearcy, R. W. (1990). Sunflecks and photosynthesis in plant canopies. Annu. Rev. Plant Physiol. Plant Mol. Biol. 41, 421-453.
- Pearcy, R. W., Ehleringer, J., Mooney, H. A., and Rundel, P. W., eds. (1989). "Plant Physiological Ecology." Chapman and Hall, New York
- Pearson, M., and Mansfield, T. A. (1993). Interacting effects of ozone and water stress on the stomatal resistance of beech (Fagus sylvatica L.). New Phytol. 123, 351-358.
- Pedersen, O. (1993). Long-distance water transport in aquatic plants. *Plant Physiol.* 103, 1369–1375.
- Peñuelas, J., and Matamala, R. (1990). Changes in N and S leaf content, stomatal density and specific leaf area of 14 plant species during the last three centuries of CO₂ increase. J. Exp. Bot. 41, 1119-1124.
- Pereira, J. S., and Kozlowski, T. T. (1977). Influence of light intensity, temperature, and leaf area on stomatal aperture and water potential of woody plants. Can. J. For. Res. 7, 145–153.
- Perry, D. A., Molina, R., and Amaranthus, M. P. (1987). Mycorrhizae, mycorrhizospheres, and reforestation: Current knowledge and research needs. Can. J. For. Res. 17, 929-940.
- Peters, D. B., and Russell, M. B. (1959). Relative water losses by evaporation and transpiration in field corn. Soil Sci. Soc. Am. Proc. 23, 170-173.
- Peterson, C. A. (1988). Exodermal Casparian bands: Their significance for ion uptake by roots. *Physiol. Plant.* 72, 204-208.
- Peterson, C. A., Emanuel, M. E., and Humphreys, G. B. (1981). Pathway of movement of apoplastic fluorescent dye tracers through the endodermis at the site of secondary root formation in corn (*Zea mays*) and broad bean (*Vicia faba*). *Can. J. Bot.* 59, 618-625.
- Peterson, C. A., and Perumalla, C. J. (1984). Development of the hypodermal Casparian band in corn and onion roots. J. Exp. Bot. 35, 51–57.
- Pfeffer, W. (1877). "Osmotische Untersuchunger." W. Englemann, Leipzig. English translation by G. R. Kepner and E. J. Stadelmann. 1985. "Osmotic Investigations: Studies on Cell Mechanics." Van Nostrand Reinhold, New York.
- Pfeffer, W. (1900). "The Physiology of Plants." 2nd Ed. English translation by A. J. Ewart. Oxford at the Clarendon Press.
- Philip, J. R. (1957). The physical principles of soil water movement during the irrigation cycle. *Proc. Int. Congr. Irrig. Drain.* 8, 124–154.
- Philip, J. R. (1958a). The osmotic cell, solute diffusibility, and the plant water economy. *Plant Physiol.* 33, 264–271.
- Philip, J. R. (1958b). Osmosis and diffusion in tissues: Half-times and internal gradients. Plant Physiol. 33, 275-278.
- Philip, J. R. (1958c). Correction to the paper entitled "Osmosis and diffusion in tissue: Half times and internal gradients." *Plant Physiol.* 33, 443.
- Philip, J. R. (1958d). Propagation of turgor and other properties through cell aggregations. Plant Physiol. 33, 271-274.
- Phillips, I. D. (1964). The importance of an aerated root system in the regulation of growth levels in the shoot of *Helianthus annuus*. Ann. Bot. (London) [N.S.] 28, 17-36.

- Pick, U., and Bassilian, S. (1982). Activation of magnesium ion specific adenosinetriphosphatase in chloroplast coupling factor 1 by octylglucoside. *Biochemistry* 24, 6144–6152.
- Pickard, W. F. (1973). A heat pulse method of measuring water flux in woody plant stems. *Math. Biosci.* 16, 247–262.
- Pier, P. A., and Berkowitz, G. A. (1987). Modulation of water stress effects on photosynthesis by altered leaf K⁺¹. *Plant Physiol.* 85, 655-661.
- Pierre, W. H., and Pohlman, G. G. (1934). The phosphorus concentration of the exuded sap of corn as a measure of the available phosphorus in the soil. J. Am. Soc. Agron. 25, 160– 171.
- Pinter, P. J., Jr., Zipoli, G., Reginato, R. J., Jackson, R. D., Idso, S. B., and Hohman, J. P. (1990). Canopy temperature as an indicator of differential water use and yield performance among wheat cultivars. Agr. Water Manag. 18, 35-48.
- Piñero, D., Sarukhan, J., and Alberdi, P. (1982). The costs of reproduction in a tropical palm, Astrocaryum mexicanum. J. Ecol. 70, 473-481.
- Pisek, A., and Cartellieri, E. (1932). Zur Kenntnis des Wasserhaushaltes der Pflanzen. I. Sonnenpflanzen. *Jahrb. Wiss. Bot.* 75, 195-251.
- Pleasants, A. L. (1930). The effect of nitrate fertilizer on stomatal behavior. J. Elisha Mitchell Sci. Soc. 46, 95-116.
- Plymale, E. L, and Wylie, R. B. (1944). The major veins of mesomorphic leaves. Am. J. Bot. 31, 99-106.
- Poljakoff-Mayber, A., and Gale, J. (1975). "Plants in Saline Environments." Springer-Verlag, New York.
- Pollard, J. K., and Sproston, T. (1954). Nitrogenous constituents of sap exuded from the sapwood of Acer saccharum. Plant Physiol. 29, 360-364.
- Portas, C. A. M., and Taylor, H. M. (1976). Growth and survival of young plant roots in dry soil. Soil Sci. 121, 170-175.
- Postlethwait, S. N., and Rogers, B. (1958). Tracing the path of the transpiration stream in trees by the use of radioactive isotopes. Am. I. Bot. 35, 753-757.
- Potrykus, I. (1991). Gene transfer to plants: Assessment of published approaches and results. Annu. Rev. Plant Physiol. Plant Mol. Biol. 42, 205-225.
- Potter, J. R., and Boyer, J. S. (1973). Chloroplast response to low leaf water potentials. II. Role of osmotic potential. *Plant Physiol.* 51, 993–997.
- Press, M. C., and Whittaker, J. B. (1993). Exploitation of the xylem stream by parasitic organisms. Phil. Trans. Roy. Soc. London Ser. B 341, 101-111.
- Preston, G. M., Carroll, T. P., Guggino, W. B., and Agre, P. (1992). Appearance of water channels in *Xenopus* oocytes expressing red cell CHIP28 protein. *Science* 256, 385-387.
- Preston, R. D. (1961). Theoretical and practical implications of the stresses in the water-conducting system. *In* "Recent Advances in Botany," pp. 1144–1149. University of Toronto Press, Toronto.
- Preston, R. D. (1974). "The Physical Biology of Plant Cell Walls." Chapman and Hall, London.
- Probine, M. C., and Preston, R. D. (1962). Cell growth and the structure and mechanical properties of the wall in internodal cells of *Nitella opaca*. II. Mechanical properties of the walls. J. Exp. Bot. 13, 111-127.
- Proebsting, E. I. (1943). Root distribution of some deciduous fruit trees in a California orchard. Proc. Am. Soc. Hort. Sci. 43, 1-4.
- Proebsting, E. L., and Gilmore, A. E. (1941). The relation of peach root toxicity to the re-establishing of peach orchards. *Am. Soc. Hort. Sci. Proc.* 38, 21-26.
- Putnam, A. R. (1983). Allelopathic chemicals. Chem. Eng. News 61, 34-45.
- Putnam, A. R., and Duke, W. B. (1978). Allelopathy in agroecosystems. Annu. Rev. Phytopathol. 16, 431-451.
- Putnam, A. R., and Tang, C. S., eds. (1986). "The Science of Allelopathy." Wiley New York.

- Quadir, A., Harrison, P. J., and DeWreede, R. E. (1979). The effects of emergence and submergence on the photosynthesis and respiration of marine macrophytes. *Phycologia* 18, 83–88.
- Queen, W. H. (1967). "Radial Movement of Water and ³²P through Suberized and Unsuberized Roots of Grape." Ph.D. Dissert., Duke University, Durham, NC.
- Quick, W. P., Chaves, M. M., Wendler, R., David, M., Rodrigues, M. L., Passaharinho, J. A., Pereira, J. S., Adcock, M. D., Leegood, R. C., and Stitt, M. (1992). The effect of water stress on photosynthetic carbon metabolism in four species grown under field conditions. *Plant Cell Environ.* 15, 25-35.
- Quisenberry, J. E., Cartwright, G. B., and McMichael, B. L. (1984). Genetic relationship between turgor maintenance and growth in cotton germplasm. Crop Sci. 24, 479–482.
- Quispel, A. (1983). Dinitrogen-fixing symbioses with legumes, non-legume angiosperms and associative symbioses. *In* "Encyclopedia of Plant Physiology" (A. Läuchli and R. L. Bieleski, eds.), Vol. 15A, pp. 286–329. Springer-Verlag, Berlin/Heidelberg.
- Raber, O. (1937). Water utilization by trees, with special reference to the economic forest species of the north temperature zone. U.S. Dept. Agr. Misc. Publ. 257.
- Racker, E. (1977). Mechanisms of energy transformations. Annu. Rev. Biochem. 46, 1006-1014.
- Radin, J. W. (1983). Control of plant growth by nitrogen: Differences between cereals and broadleaf species. *Plant Cell Environ.* 6, 65-68.
- Radin, J. W. (1984). Stomatal responses to water stress and to abscisic acid in phosphorus-deficient cotton plants. *Plant Physiol.* 76, 392-394.
- Radin, J. W., and Ackerson, R. C. (1981). Water relations of cotton plants under nitrogen deficiency. III. Stomatal conductance, photosynthesis, and abscisic acid accumulation during drought. *Plant Physiol.* 67, 115-119.
- Radin, J. W., and Boyer, J. S. (1982). Control of leaf expansion by nitrogen nutrition in sunflower plants: Role of hydraulic conductivity and turgor. *Plant Physiol.* **69**, 771–775.
- Radin, J. W., and Matthews, M. A. (1989). Water transport properties of cortical cells in roots of nitrogen- and phosphorus-deficient cotton seedlings. *Plant Physiol.* 89, 264–268.
- Radin, J. W., and Parker, L. L. (1979a). Water relations of cotton plants under nitrogen deficiency. I. Dependence upon leaf structure. *Plant Physiol.* 64, 495–498.
- Radin, J. W., and Parker, L. L. (1979b). Water relations of cotton plants under nitrogen deficiency. II. Environmental interactions on stomata. *Plant Physiol.* 64, 499-501.
- Radin, J. W., Reaves, L. L., Mauney, J. R., and French, O. F. (1992). Yield enhancement in cotton by frequent irrigation during fruiting. *Agron. J.* 84, 551–557.
- Radler, F. (1965). Reduction of loss of moisture by the cuticle wax components of grapes. *Nature* (London) 207, 1002–1003.
- Raison, J. K., Pike, C. S., and Berry, J. A. (1982). Growth temperature-induced alterations in the thermotropic properties of *Nerium oleander* membrane lipids. *Plant Physiol.* 70, 215–218.
- Rand, R. (1983). Fluid mechanics of green plants. Annu. Rev. Fluid. Mech. 15, 29-45.
- Rand, R. P. (1992). Raising water to new heights. Science 256, 618.
- Raney, F., and Vaadia, Y. (1965a). Movement of tritiated water in the root system of *Helianthus annuus* in the presence and absence of transpiration. *Plant Physiol.* 40, 378–382.
- Raney, R., and Vaadia, Y. (1965b). Movement and distribution of THO in tissue water and vapor transpired by shoots of *Helianthus* and *Nicotiana*. *Plant Physiol.* 40, 383–388.
- Rao, A. S. (1990). Root flavonoids. Bot. Rev. 56, 1-84.
- Rao, I. M., Sharp, R. E., and Boyer, J. S. (1987). Leaf magnesium alters photosynthetic response to low water potentials in sunflower. *Plant Physiol.* 84, 1214–1219.
- Raper, C. D., Jr., and Barber, S. A. (1970a). Rooting systems of soybeans. I. Differences in root morphology among varieties. *Agron. J.* 62, 581-584.
- Raper, C. D., Jr., and Barber, S. A. (1970b). Rooting systems of soybeans. II. Physiological effectiveness as nutrient absorption surfaces. Agron. J. 62, 686-588.

- Raper, C. D., Jr., and Kramer, P. J., eds. (1983). "Crop Reactions to Water and Temperature Stresses in Humid, Temperate Climates." Westview Press, Boulder, CO.
- Raper, C. D., Jr., and Kramer, P. J. (1987). Stress physiology. In "Soybeans" (J. R. Wilcox, ed.), 2nd Ed., pp. 589-641. American Society of Agronomy, Madison, WI.
- Raper, C. D., Jr., Patterson, D. T., Parsons, L. R., and Kramer, P. J. (1977). Relative growth and nutrient accumulation rates for tobacco. *Plant Soil* 46, 473-486.
- Raschke, K. (1970). Leaf hydraulic system: Rapid epidermal and stomatal responses to changes in water supply. *Science* 167, 189–191.
- Raschke, K. (1972). Saturation kinetics of the velocity of stomatal closing in response to CO₂. Plant Physiol. 49, 229-234.
- Raschke, K. (1975). Stomatal action. Annu. Rev. Plant Physiol. 26, 309-340.
- Raschke, K. (1976). How stomata resolve the dilemma of opposing priorities. Phil. Trans. Roy. Soc. London Ser. B 273, 551–560.
- Raschke, K. (1986). The influence of the CO₂ content of the ambient air on stomatal conductance and the CO₂ concentration in leaves. *In* "Carbon Dioxide Enrichment of Greenhouse Crops" (H. Z. Enoch and B. A. Kimball, eds.), Vol. 2, pp. 87–102. CRC Press, Boca Raton, FL.
- Raschke, K., and Hedrich, R. (1985). Simultaneous and independent effects of abscisic acid on stomata and the photosynthetic apparatus in whole leaves. *Planta* 163, 105-118.
- Rascio, A., Platani, C., Di Fonzo, N., and Wittmer, G. (1992). Bound water in durum wheat under drought stress. *Plant Physiol.* 98, 908–912.
- Raskin, I., and Kende, H. (1985). Mechanism of aeration in rice. Science 228, 327-329.
- Raven, J. A. (1983). Phytophages of xylem and phloem: a comparison of animal and plant sapfeeders. Adv. Ecol. Res. 13, 135-234.
- Ravina, I., and Magier, J. (1984). Hydraulic conductivity and water retention of clay soils containing coarse fragments. Soil Sci. Soc. Am. J. 48, 736–740.
- Rawlins, S. L. (1963). "Resistance to Water Flow in the Transpiration Stream," pp. 69-85. Bull. 664, Conn. Agric. Exp. Stn., New Haven.
- Rawlins, S. L., and Dalton, F. N. (1967). Psychrometric measurement of soil water potential without precise temperature control. Proc. Soil Sci. Soc. Am. 31, 297–301.
- Ray, P. M. (1960). On the theory of osmotic water movement. Plant Physiol. 35, 783-795.
- Ray, P. M. (1967). Autoradiographic study of cell wall deposition in growing plant cells. J. Cell Biol. 35, 659-674.
- Rayan, A., and Matsuda, K. (1988). The relation of anatomy to water movement and cellular response in young barley leaves. *Plant Physiol.* 87, 853–858.
- Read, D. W. L., Vleck, S. V., and Pelton, W. L. (1962). Self-irrigating greenhouse pots. Agron. J. 54, 457-4770.
- Reckmann, U., Scheibe, R., and Raschke, K. (1990). Rubisco activity in guard cells compared with the solute requirement for stomatal opening. *Plant Physiol.* 92, 246–253.
- Reed, H. S., and MacDougal, T. (1937). Periodicity in the growth of the orange tree. Growth 1, 371-373.
- Reed, J. F. (1939). "Root and Shoot Growth of Shortleaf and Loblolly Pines in Relation to Certain Environmental Conditions." Duke Univ. Sch. For. Bull. 4.
- Reich, P. B., Teskey, R. O., Johnson, P. S., and Hinckley, T. M. (1980). Periodic root and shoot growth in oak. For. Sci. 26, 590-598.
- Reicosky, D. C., and Ritchie, J. T. (1976). Relative importance of soil resistance and plant resistance in root water absorption. Soil Sci. Soc. Am. J. 40, 293-297.
- Reid, D. M., and Crozier, A. (1971). Effects of waterlogging on the gibberellin content and growth of tomato plants. J. Exp. Bot. 22, 39-48.
- Reid, E. W. (1890). Osmosis experiments with living and dead membranes. J. Physiol. (London) 11, 312-351.

- Reid, J. B., Sorensen, I., and Petrie, R. A. (1993). Root demography in kiwifruit (Actinidia deliciosa). Plant Cell Environ. 16, 949-957.
- Reimann, E. G., Van Doren, C. A., and Stauffer, R. S. (1946). Soil moisture relationships during crop production. Soil Sci. Soc. Am. Proc. 10, 41-46.
- Reisner, M. (1986). "Cadillac Desert." Viking Penguin, New York.
- Renger, M., Strebel, O., Grimme, H., and Fleige, H. (1981). Nährstoffanlieferung an die Pflanzenwurzel durch Massenfluss. *Mitt. Dtsch. Bodenkd. Ges.* 30, 63-70.
- Renner, O. (1912). Versuche zur Mechanik der Wasserversorgung. 2. Über wurzeltätigkeit. Ber. Dtsch. Bot. Ges. 30, 642-648.
- Renner, O. (1915). Die Wasserversorgung der Pflanzen. Handworterbuch Naturwiss. 10, 538-557.
- Repp, G. I., McAlister, D. R., and Wiebe, H. H. (1959). Salt resistance of protoplasm as a test for salt tolerance of agricultural plants. *Agron. J.* 51, 311-314.
- Rhine, J. B. (1924). Clogging of stomata of conifers in relation to smoke injury and distribution. Bot. Gaz. 78, 226-232.
- Rhodes, L. H., and Gerdemann, J. W. (1975). Phosphate uptake zones of mycorrhizal and non-mycorrhizal onions. *New Phytol.* 75, 555-561.
- Rice, E. L. (1984). "Allelopathy," 2nd Ed. Academic Press, Orlando, FL.
- Richards, J. H., and Caldwell, M. M. (1987). Hydraulic lift: Substantial nocturnal transport of water between soil layers by *Artemisia tridentata* roots. *Oecologia* 73, 486–489.
- Richards, L. A. (1949). Methods of measuring soil moisture tension. Soil Sci. 68, 95-112.
- Richards, L. A. (1954). "Diagnosis and Improvement of Saline and Alkaline Soils." U.S. Dept. Agr. Handbook 60.
- Richards, L. A., and Ogata, G. (1958). Thermocouple for vapor pressure measurements in biological and soil systems at high humidity. *Science* 128, 1089–1090.
- Richards, L. A., and Wadleigh, C. H. (1952). Soil water and plant growth. *In* "Soil Physical Conditions and Plant Growth" (B. T. Shaw, ed.) pp. 73-251. Academic Press, New York.
- Richards, L. A., and Weaver, L. B. (1944). Moisture retention by some irrigated soils as related to soil moisture tension. J. Agric. Res. 69, 215-235.
- Richards, S. J., and Marsh, A. W. (1961). Irrigation based on soil suction measurements. Soil Sci. Soc. Am. Proc. 25, 65-69.
- Richardson, M. D., Meisner, C. A., Hoveland, C. S., and Karnok, K. J. (1992). Time domain reflectometry in closed container studies. *Agron. J.* 84, 1061–1063.
- Richardson, S. D. (1953). Root growth of Acer pseudoplatanus L. in relation to grass cover and nitrogen deficiency. Meded. Landbouwhogesch. Wageningen.
- Richmond, P. A., Métraux, J.-P., and Taiz, L. (1980). Cell expansion patterns and directionality of wall mechanical properties in *Nitella Plant Physiol.* 65, 211–217.
- Richter, C., and Marschner, H. (1973). Umtausch von Kalium in verschiedener Wurzelzanen von Maiskeimpflanzen. Z. Pflanzenphysiol. 70, 211-221.
- Richter, D. D., King, K. S., and Witter, J. A. (1989). Moisture and nutrient status of extremely acid umbrechts in the Black Mountains of North Carolina. Soil Sci. Soc. Am. J. 53, 1222-1228.
- Rider, N. E. (1957). Water losses from various land surfaces. Quart. J. Roy. Meteorol. Soc. 83, 181-183.
- Ristaino, J. B., and Duniway, J. M. (1991). The impact of *Phytophthora* root rot on water extraction from the soil by roots of field-grown processing tomatoes. *J. Am. Soc. Hort. Sci.* 116, 603–608.
- Ristic, Z., and Ashworth, E. N. (1993). Ultrastructural evidence that intracellular ice formation and possibly cavitation are the sources of freezing injury in supercooling wood tissue of *Cornus florida* L. *Plant Physiol.* 103, 753-761.
- Ritman, K. T., and Milburn, J. A. (1991). Monitoring of ultrasonic and audible emissions from plants with or without vessels. J. Exp. Bot. 42, 123-130.

- Roach, W. A. (1934). Injection for the diagnosis and cure of physiological disorders of fruit trees. Ann. Appl. Biol. 21, 333-343.
- Robards, A. W., and Lucas, W. J. (1990). Plasmodesmata. Annu. Rev. Plant Physiol. Plant Mol. Biol. 41, 369-419.
- Robb, J., Busch, L., and Rauser, W. E. (1980). Zinc toxicity and xylem vessel wall alterations in white beans. Ann. Bot. 46, 43-50.
- Robb, J., Lee, S.-W., Mohan, R., and Kolattukudy, P. E. (1991). Chemical characterization of stress-induced vascular coating in tomato. *Plant Physiol.* 97, 528-536.
- Robb, J., Smith, A., Brisson, J. D., and Busch, L. (1979). Ultrastructure of wilt syndrome caused by Verticillium dahliae. VI. Interpretive problems in the study of vessel coatings and tyloses. Can. J. Bot. 57, 795-821.
- Robbins, E., and Mauro, A. (1960). Experimental study of the independence of diffusion and hydrodynamic permeability coefficients in collodion membranes. J. Gen. Physiol. 43, 523-532.
- Roberts, F. L. (1948). "A Study of the Absorbing Surfaces of the Roots of Loblolly Pine." M.A. Thesis, Duke University, Durham, NC.
- Roberts, J. (1977). The use of tree-cutting techniques in the study of water relations of mature *Pinus sylvestris* L. J. Exp. Bot. 28, 751-767.
- Roberts, J. (1983). Forest transpiration: a conservative hydrological process? J. Hydrol. 66, 133-144.
- Roberts, J. K. M. (1984). Study of plant metabolism in vivo using NMR spectroscopy. Annu. Rev. Plant Physiol. 35, 375-386.
- Roberts, J. K. M., Andrade, F. H., and Anderson, I. C. (1985). Further evidence that cytoplasmic acidosis is a determinant of flooding intolerance in plants. *Plant Physiol.* 77, 492–494.
- Roberts, R. H., and Struckmeyer, B. E. (1946). The effect of top environment and flowering upon top-root ratios. *Plant Physiol.* 21, 332–344.
- Robeson, D. J., Bretschneider, K. E., and Gonella, M. P. (1989). A hydathode inoculation technique for the simulation of natural black rot infection of cabbage by *Xanthomonas campestris* pv. campestris. Ann. Appl. Biol. 115, 455-459.
- Robichaux, R. H., and Pearcy, R. W. (1984). Evolution of C₃ and C₄ plants along an environmental moisture gradient: Patterns of photosynthetic differentiation in Hawaiian *Scaevola* and *Euphorbia* species. *Am. J. Bot.* 71, 121–129.
- Robinson, D. G., and Cummins, W. R. (1976). Golgi secretion in plasmolyzed *Pisum sativum L. Protoplasma* **90**, 369-379.
- Robinson, D. G., and Ray, P. M. (1977). The reversible cyanide inhibition of Golgi secretion in peacells. Eur. J. Cell Biol. 15, 65-77.
- Robinson, S. P., Grant, W. J. R., and Loveys, B. R. (1988). Stomatal limitation of photosynthesis in abscisic acid-treated and in water-stressed leaves measured at elevated CO₂. Aust. J. Plant Physiol. 15, 495-503.
- Rogers, H. H., Bingham, G. E., Cure, J. D., Smih, J. M., and Surano, K. A. (1983). Responses of selected plant species to elevated CO₂ in the field. *J. Environ. Qual.* 12, 569-574.
- Rogers, H. H., and Bottomley, P. A. (1987). In situ nuclear magnetic resonance imaging of roots: Influence of soil type, ferromagnetic particle content and soil water. Agron. J. 79, 957-965.
- Rogers, H. H., Peterson, C. M., McCrimmon, J. N., and Cure, J. D. (1992). Response of plant roots to elevated atmospheric carbon dioxide. *Plant Cell Environ.* 15, 749-752.
- Rogers, W. S. (1929). Winter activity of the roots of perennial plants. Science 69, 299-300.
- Romberger, J. A. (1963). "Meristems, Growth, and Development in Woody Plants." U.S. Dep. Agr. Tech. Bull. 1293.
- Rose, C. W., Stern, W. R., and Drummond, J. E. (1965). Determination of hydraulic conductivity as a function of depth and water content for soil *in situ*. Aust. J. Soil Res. 3, 1-9.
- Rosene, H. F. (1935). Proof of the principle of summation of cell E.M.F.'s. *Plant Physiol.* 10, 209–224.

- Rosenzweig, M. L. (1968). Net primary productivity of terrestrial communities: Prediction from climatological data. Am. Nat. 102, 67-74.
- Ruben S., Randall, M., and Hyde, J. L. (1941). Heavy oxygen (O18) as a tracer in the study of photosynthesis. J. Am. Chem. Soc. 63, 877-879.
- Rudinsky, J. A., and Vitè, J. P. (1959). Certain ecological and phylogenetic aspects of the pattern of water conduction in conifers. For. Sci. 5, 259–266.
- Rufelt, H. (1956). Influence of the root pressure on the transpiration of wheat plants. *Physiol. Plant.* 9, 154-164.
- Rundel, P. W. (1973). The relationship between basal fire scars and crown damage in giant sequoia. Ecology 54, 210-213
- Rundel, P. W. (1982). Water uptake by organs other than roots. *In* "Encyclopedia of Plant Physiology" (O. L. Lange, P. S. Nobel, C. B. Osmond and H. Ziegler, eds.), Vol. 12B, pp. 111–134. Springer-Verlag, New York.
- Rundel, P. W., Ehleringer, J. R., and Nagy, K. A., eds. (1988). "Stable Isotopes in Ecological Research," Ecol. Studies 68. Springer-Verlag, New York.
- Running, S. W. (1980). Field estimates of root and xylem resistance in *Pinus contorta* using root excision. *J. Exp. Bot.* 31, 555-569.
- Rupley, J. A., Gratton, E., and Careri, G. (1983). Water and globular proteins. *Trends Biochem. Sci.* 8, 18-22.
- Rushin, J. W., and Anderson, J. E. (1981). An examination of the leaf quaking adaptation and stomatal distribution in *Populus tremuloides* Michx. *Plant Physiol.* 67, 1264–1266.
- Russell, R., and Barber, D. A. (1960). The relationship between salt uptake and the absorption of water by intact plants. *Annu. Rev. Plant Physiol.* 11, 127-140.
- Rygol, J., and Lüttge, U. (1983). Water-relation parameters of giant and normal cells of Capsicum annuum pericarp. Plant Cell Environ. 6, 545-553.
- Rygol, J., Pritchard, J., Zhu, J. J., Tomos, A. D., and Zimmermann, U. (1993). Transpiration induces radial turgor pressure gradients in wheat and maize roots. *Plant Physiol.* 103, 493–500.
- Saab, I. N., and Sharp, E. R. (1989). Non-hydraulic signals from maize roots in drying soil: Inhibition of leaf elongation but not stomatal conductance. *Planta* 179, 466–474.
- Saab, I. N., Sharp, R. E., Pritchard, J., and Voetberg, G. S. (1990). Increased endogenous abscisic acid maintains primary root growth and inhibits shoot growth of maize seedlings at low water potentials. *Plant Physiol.* 93, 1329-1336.
- Sachs, J. (1873). Über das Wachstum der Haupt und Nebenwurzeln. Arb. Bot. Inst. Wurzburg 3, 395-477, 584-634.
- Sachs, J. von (1875). "History of Botany, 1530–1860." English Translation by Garnsay, Clarendon Press, Oxford.
- Sachs, J. von (1882a). "Lectures On the Physiology of Plants," 2nd Ed., English Translation by Ward, Oxford University Press, 1887.
- Sachs, J. von (1882b). "Textbook of Botany," 2nd Ed., English Translation by Virres. Clarendon Press, Oxford.
- Sachs, T., and Novoplansky, N. (1993). The development and patterning of stomata and glands in the epidermis of *Peperomia*. New Phytol. 123, 567-574.
- Sachs, T., Novoplansky, A., and Cohen, D. (1993). Plants as competing populations of redundant organs. *Plant Cell Environ.* 16, 765-770.
- Safir, G. R. (ed.) (1987). "Ecophysiology of VA Mycorrhizal Plants." CRC Press, Boca Raton, FL.
- Safir, G. R., Boyer, J. S., and Gerdemann, J. W. (1971). Mycorrhizal enhancement of water transport in soybean. *Science* 172, 581-583.
- Safir, G. R., Boyer, J. S., and Gerdemann, J. W. (1972). Nutrient status and mycorrhizal enhancement of water transport in soybean. *Plant Physiol.* 49, 700-703.
- Saini, H. S., and Aspinall, D. (1981). Effect of water deficit on sporogenesis in wheat (Triticum aestivum L.). Ann. Bot. 48, 623-633.

- Saini, H. S., and Aspinall, D. (1982). Sterility in wheat (Triticum aestivum L.) induced by water stress or high temperature: Possible mediation by abscisic acid. Aust. J. Plant Physiol. 9, 529– 537.
- Saini, H. S., Sedgley, M., and Aspinall, D. (1984). Developmental anatomy in wheat of male sterility induced by heat stress, water deficit or abscisic acid. Aust. J. Plant Physiol. 11, 243–254.
- Sakuratani, T. (1981). A heat balance method for measuring water flux in the stem of intact plants. I. Agric. Met. 37, 9-17.
- Salé, G. (1983). Germination and establishment of Viscum album L. In "The Biology of Misteltoes" (M. Calder and P. Bernhardt, eds.), pp. 145-159. Academic Press, New York.
- Salter, P. J., and Goode, J. E. (1967). "Crop Responses to Water at Different Stages of Growth." Commonwealth Agricultural Bureau, Franham Royal, Bucks, England.
- Sammons, D. J., Peters, D. B., and Hymowitz, T. (1978). Screening soybeans for drought resistance. I. Growth chamber procedure. *Crop Sci.* 18, 1050-1055.
- Sammons, D. J., Peters, D. B., and Hymowitz, T. (1979). Screening soybeans for drought resistance. II. Drought box procedure. *Crop Sci.* 19, 719–722.
- Sampson, D. A., and Smith, F. W. (1993). Influence of canopy architecture on light penetration in lodgepole pine (*Pinus contorta* var. *latifolia*) forests. *Agric. For. Meteorol.* **64**, 63-79.
- Sánchez-Díaz, M. F., and Kramer, P. J. (1971). Behavior of corn and sorghum under water stress and during recovery. *Plánt Physiol.* 48, 613-616.
- Sánchez-Díaz, M., Pardo, M., Antolín, M., Peña, J., and Aguirreolea, J. (1990). Effect of water stress on photosynthetic activity in the *Medicago-Rhizobium-Glomus* symbiosis. *Plant Sci.* 71, 215–221.
- Sanders, F. E., and Tinker, P. B. (1971). Mechanism of absorption of phosphate from soil by *Endogone* mycorrhizas. *Nature* (London) 232, 278-279.
- Sanderson, J. (1983). Water uptake by different regions of the barley root: Pathways of radial flow in relation to development of the endodemis. J. Exp. Bot. 34, 240-253.
- Sandford, A. P., and Jarvis, P. G. (1986). Stomatal response to humidity in selected conifers. Tree Physiol 2, 89-103.
- Sands, R., Fiscus, E. L., and Reid, C. P. P. (1982). Hydraulic properties of pine and bean roots with varying degrees of suberization, vascular differentiation and mycorrhizal infection. Aust. J. Plant Physiol. 9, 559-569.
- Sands, R., and Reid, C. P. P. (1980). The osmotic potential of soil water in plant/soil systems. Aust. J. Soil Res. 18, 13-25.
- Santarius, K. A. (1969). The effect of freezing and desiccation of chloroplasts in the presence of electrolytes. *Planta* 89, 23–46.
- Santarius, K. A., and Giersch, C. (1984). Factors contributing to inactivation of isolated thylakoid membranes during freezing in the presence of variable amounts of glucose and NaCl. *Biophys. I.* 46, 129–139.
- Sarquis, J. I., Jordan, W. R., and Morgan, P. W. (1992). Effect of atmospheric pressure on maize root growth and ethylene production. *Plant Physiol.* 100, 2106–2108.
- Sauter, J. J. (1971). "Physiology of Sugar Maple," pp. 10-11. Harvard For. Annu. Rept., 1970-1971.
- Sayre, J. D. (1926). Physiology of stomata of Rumex patientia. Ohio J. Sci. 26, 233-266.
- Scandalios, J. G. (1993). Oxygen stress and superoxide dismutases. Plant Physiol. 101, 7-12.
- Scheibe, R., Reckmann, U., Hedrick, R., and Raschke, K. (1990). Malate dehydrogenases in guard cells of *Pisum sativum. Plant Physiol.* 93, 1358-1364.
- Schiefelbein, J. W., and Somerville, C. (1990). Genetic control of root hair development in *Arabidopsis thaliana*. *Plant Cell* 2, 235-243.
- Schildwacht, P. M. (1989). Is a decrease in water potential after withholding oxygen to roots the cause of the decline of leaf-elongation rates in *Zea mays* L. and *Phaseolus vulgaris* L.? *Planta* 177, 178-184.

- Schmalstig, J. G., and Cosgrove, D. J. (1990). Coupling of solute transport and cell expansion in pea stems. *Plant Physiol.* 94, 1625-1633.
- Schnabl, H., and Ziegler, H. (1977). The mechanism of stomatal movement in Allium cepa L. Planta 136, 37-43.
- Schneider, G. W., and Childers, N. F. (1941). Influence of soil moisture on photosynthesis, respiration, and transpiration of apple leaves. *Plant Physiol.* 16, 565-583.
- Scholander, P. F., Bradstreet, E. D., Hammel, H. T., and Hemmingsen, E. A. (1966). Sap concentrations in halophytes and some other plants. *Plant Physiol.* 41, 529-532.
- Scholander, P. F., Hammel, H. T., Bradstreet, E. D., and Hemmingsen, E. A. (1965). Sap pressure in vascular plants. *Science* 148, 339-346.
- Scholander, P. F., Hammel, H. T., Hemmingsen, E. A., and Bradstreet, E. D. (1964). Hydrostatic pressure and osmotic potential in leaves of mangroves and some other plants. *Proc. Natl. Acad. Sci. USA* 52, 119–125.
- Schönherr, J. (1976). Water permeability of isolated cuticular membranes: the effect of cuticular waxes on diffusion of water. *Planta* 131, 159-164.
- Schönherr, J., and Ziegler, H. (1980). Water permeability of *Betula* periderm. *Planta* 147, 345-354.
- Schopfer, P. (1989). pH dependence of extension growth in *Avena* coleoptiles and its implications for the mechanisms of auxin action. *Plant Physiol.* **90**, 202–207.
- Schroeder, P. (1989). Characterization of a thermo-osmotic gas transport mechanism in Alnus glutinosa (L.) Gaert. Trees 3, 38-44.
- Schroeder, R. A. (1939). The effect of root temperature upon the absorption of water by the cucumber. *Univ. Missouri Res. Bull.* 309, 1–27.
- Schulte, P. J., and Castle, A. L. (1993). Water flow through vessel perforation plates: A fluid mechanical approach. J. Exp. Bot. 44, 1135-1142.
- Schultz, J. C., and Raskin, I., eds. (1994). "Plant Signals in Interactions with Other Organisms." Current Topics in Plant Physiology, Vol. 11. Amer. Soc. Plant Physiologists, Rockville, MD.
- Schultz, R. P. (1972). Intraspecific root grafting in slash pine. Bot. Gaz. 133, 26-29.
- Schulz, K. E., Smith, M., and Wu, Y. (1993). Gas exchange of *Impatiens pallida* Nutt. (Balsaminaceae) in relation to wilting under high light. *Am. J. Bot.* **80**, 361–368.
- Schulze, E.-D. (1986a). Whole-plant responses to drought. Aust. J. Plant Physiol. 13, 127-141.
- Schulze, E.-D. (1986b). Carbon dioxide and water vapor exchange in response to drought in the atmosphere and in the soil. *Annu. Rev. Plant Physiol.* 37, 247–274.
- Schulze, E.-D., and Bloom, A. J. (1984). Relationship between mineral nitrogen influx and transpiration in radish and tomato. *Plant Physiol.* 76, 827–828.
- Schulze, E.-D., Cermák, J., Matyssek, R., Penka, M., Zimmermann, R., Vasícek, F., Gries, W., and Kučera, J. (1985). Canopy transpiration and water fluxes in the xylem of the trunk of *Larix* and *Picea* trees: A comparison of xylem flow, porometer and cuvette measurements. *Oecologia* 66, 475-483.
- Schulze, E.-D., and Hall, A. E. (1982). Stomatal responses, water loss and CO₂ assimilation rates of plants in contrasting environments. *In* "Encyclopedia of Plant Physiology" (O. L. Lange, P. S. Nobel, C. B. Osmond, and H. Ziegler, eds.), Vol. 12B, pp. 181–230. Springer-Verlag.
- Schulze, E.-D., Lange, O. L., Buschbom, U., Kappen, L., and Evenari, M. (1972). Stomatal responses to changes in humidity in plants growing in the desert. *Planta* 108, 259–270.
- Schussler, J. R., and Westgate, M. E. (1991a). Maize Kernel set at low water potential. I. Sensitivity to reduced assimilates during early kernel growth. *Crop Sci.* 31, 1189-1195.
- Schussler, J. R., and Westgate, M. E. (1991b). Maize kernel set at low water potential. II. Sensitivity to reduced assimilates at pollination. *Crop Sci.* 31, 1196–1203.
- Schwenke, H., and Wagner, E. (1992). A new concept of root exudation. *Plant Cell Environ.* 15, 289-299.
- Scott, F. M. (1963). Root hair zone of soil-grown plants. Nature (London) 199, 1009-1010.

- Scott, F. M. (1964). Lipid deposition in the intercellular space. Nature (London) 203, 164-165.
- Scott, F. M. (1966). Cell wall surface of the higher plants. Nature (London) 210, 1015-1017.
- Scott, L. I., and Priestley, J. H. (1928). The root as an absorbing organ. I. A reconsideration of the entry of water and salts in the absorbing region. *New Phytol.* 27, 125-140.
- Scott, N. S., Munns, R, and Barlow, E. W. R. (1979). Polyribosome content in young and aged wheat leaves subjected to drought. J. Exp. Bot. 30, 905-911.
- Sellin, A. (1993). Resistance to water flow in xylem of *Picea abies* (L.) Karst. trees grown under contrasting light conditions. *Trees* 7, 220–226.
- Sendak, P. E. (1978). Birch sap utilization in the Ukraine. J. For. 76, 120-121.
- Serpe, M. D., and Matthews, M. A. (1992). Rapid changes in cell wall yielding of elongating Begonia argenteo-guttata L. leaves in response to changes in plant water status. Plant Physiol. 100, 1852-1857.
- Serrano, E., Zeiger, E., and Hagiwara, S. (1988). Red light stimulates an electrogenic proton pump in Vicia guard cell protoplasts. Proc. Natl. Acad. Sci. USA 85, 436-440.
- Seyfried, M. S. (1993). Field calibration and monitoring of soil-water content with fiberglass electrical sensors. *J. Soil Sci. Soc. Am.* 57, 1432–1436.
- Shackel, K. A., Matthews, M. A., and Morrison, J. C. (1987). Dynamic relation between expansion and cellular turgor in growing grape (Vitis vinifera L.) leaves. Plant Physiol. 84, 1166-1171.
- Shahak, Y. (1986). Regulation of the chloroplast H+-ATPase by light. Eur. J. Biochem. 154, 179-185.
- Shaner, D. L., and Boyer, J. S. (1976a). Nitrate reductase activity in maize (*Zea mays L.*) leaves. I. Regulation by nitrate flux. *Plant Physiol.* 58, 449-504.
- Shaner, D. L., and Boyer, J. S. (1976b). Nitrate reductase activity in maize (*Zea mays L.*) leaves. II. Regulation by nitrate flux at low leaf water potentials. *Plant Physiol.* 58, 505-509.
- Shantz, H. L. (1925). Soil moisture in relation to the growth of plants. J. Am. Soc. Agron. 17, 705-711.
- Sharkey, T. D., and Seemann, J. R. (1989). Mild water stress effects on carbon-reduction-cycle intermediates, ribulose bisphosphate carboxylase activity, and spatial homogeneity of photosynthesis in intact leaves. *Plant Physiol.* 89, 1060–1065.
- Sharp, R. E., and Boyer, J. S. (1986). Photosynthesis at low water potentials in sunflower: Lack of photoinhibitory effects. *Plant Physiol.* 82, 90-95.
- Sharp, R. E., and Davies, W. J. (1979). Solute regulation and growth by roots and shoots of waterstressed maize plants. *Planta* 147, 43-49.
- Sharp, R. E., and Davies, W. J. (1985). Root growth and water uptake by maize plants in drying soil. J. Exp. Bot. 36, 1441-1456.
- Sharp, R. E., Hsiao, T. C., and Silk, W. K. (1990). Growth of maize primary root at low water potentials. II. Role of growth and deposition of hexose and potassium in osmotic adjustment. *Plant Physiol.* 93, 1337–1346.
- Sharp, R. E., Silk, W. K., and Hsiao, T. C. (1988). Growth of the maize primary root at low water potentials. I. Spatial distribution of expansive growth. *Plant Physiol.* 87, 50-57.
- Sheehy, J. E., Minchin, R. F., and Witty, J. F. (1985). Control of nitrogen fixation in a legume nodule: An analysis of the role of oxygen diffusion in relation to nodule structure. *Ann. Bot.* 55, 549–562.
- Sheriff, D. W. (1977a). Evaporation sites and distillation in leaves. Ann. Bot. 41, 1081-1082.
- Sheriff, D. W. (1977b). Where is humidity sensed when stomata respond to it directly? *Ann. Bot.* N.S. 41, 1083-1084.
- Sheriff, D. W. (1984). Epidermal transpiration and stomatal response to humidity: Some hypotheses explored. *Plant Cell Environ.* 7, 669–677.
- Shimazaki, K.-I., and Zeiger, E. (1985). Cyclic and noncyclic photophosphorylation in isolated guard cell chloroplasts from *Vicia faba* L. *Plant Physiol.* 78, 211-214.
- Shimshi, D. (1963a). Effect of chemical closure of stomata on transpiration in varied soil and atmospheric environments. Plant Physiol. 38, 709-712.

- Shimshi, D. (1963b). Effect of soil moisture and phenylmercuric acetate upon stomatal aperture, transpiration, photosynthesis. *Plant Physiol.* 38, 713-721.
- Shinozaki, K., Yoda, K., Hozumi, K., and Kira, T. (1964a). A quantitative analysis of plant form: The pipe model theory. I. Basic analyses. *Jap. J. Ecol.* 14, 97-105.
- Shinozaki, K., Yoda, K., Hozumi, K., and Kira T. (1964b). A quantative analysis of plant form: The pipe model theory. II. Further evidence of the theory and its application in forest ecology. *Jap. J. Ecol.* 14, 133–139.
- Shiraishi, M., Hashimoto, Y., and Kuraishi, S. (1978). Cyclic variations of stomatal aperture observed under the scanning electron microscope. *Plant Cell Physiol.* 19, 637–645.
- Shirazi, G. A., Stone, J. F., and Todd, G. W. (1976). Oscillatory transpiration in a cotton plant. J. Exp. Bot. 27, 608-618.
- Shirk, H. G. (1942). Freezable water content and the oxygen respiration in wheat and rye grain at different stages of ripening. Am. J. Bot. 29, 105-109.
- Shive, J. B., Jr., and Brown, K. W. (1978). Quaking and gas exchange in leaves of cottonwood (*Populus deltoides*, Marsh). *Plant Physiol.* 61, 331-333.
- Shmueli, E. (1971). The contribution of research to the efficient use of water in Israel agriculture. Z. Bewässerungswirtsch. 6, 38-58.
- Shone, M. G. T., and Clarkson, D. T. (1988). Rectification of radial water flow in the hypodemis of nodal roots of *Zea mays. Plant Soil* 111, 223-229.
- Shoup, S., and Whitcomb, C. (1981). Interaction between trees and ground covers. J. Arboricult. 7, 186–187.
- Shull, C. A. (1916). Measurement of the surface forces in soils. Bot. Gaz. (Chicago) 62, 1-31.
- Shull, C. A. (1930). Absorption of water and the forces involved. J. Am. Soc. Agron. 22, 459-471.
- Shumway, L. K., Weier, T. E., and Stocking, C. R. (1967). Crystalline structures in *Vicia faba* chloroplasts. *Planta* 76, 182–189.
- Silk, W. K., and Wagner, K. K. (1980). Growth-sustaining water potential distributions in the primary corn root. *Plant Physiol.* 66, 859–863.
- Simonneau, T., Habib, R., Goutouly, J.-P., and Huguet, J.-G. (1993). Diurnal changes in stem diameter depend upon variations in water content: Direct evidence in peach trees. J. Exp. Bot. 44, 615-621.
- Sinclair, T. R., and Ludlow, M. M. (1985). Who taught plants thermodynamics? The unfilled potential of plant water potential. Aust. J. Plant Physiol. 12, 213-217.
- Sinclair, W. B., and Bartholomew, E. T. (1944). Effects of rootstock and environment on the composition of oranges and grapefruit. *Hilgardia* 16, 125-176.
- Sionit, N., and Kramer, P. J. (1977). Effect of water stress during different stages of growth of soybean. Agron. J. 69, 274-278.
- Sionit, N., and Kramer, P. J. (1986). Woody plant reactions to CO₂ enrichment. *In* "Carbon Dioxide Enrichment of Greenhouse Crops" (H. Z. Enoch and B. A. Kimball, eds...), pp. 69–85. CRC Press, Boca Raton, FL.
- Sionit, N., Teare, I. D., and Kramer, P. J. (1980). Effects of repeated application of water stress on water status and growth of wheat. *Physiol. Plant.* 50, 11-15.
- Skene, K. G. M. (1967). Gibberellin-like substances in root exudate of Vitis vinifera. Planta 74, 250-262.
- Skidmore, E. L., and Stone, J. F. (1964). Physiological role in regulating transpiration rate of the cotton plant. *Agron. I.* 56, 405-410.
- Skujins, J. J., and McLaren, A. D. (1967). Enzyme reaction rates at limited water activities. Science 158, 1569-1570.
- Slatyer, R. O. (1957). The significance of the permanent wilting percentage in studies of plant and soil water relations. Bot. Rev. 23, 585-636.
- Slatyer, R. O. (1967). "Plant-Water Relationships." Academic Press, New York.
- Slatyer, R. O., and Bierhuizen, J. F. (1964a). A differential psychrometer for continuous measurements of transpiration. Plant Physiol. 39, 1051-1056.

- Slatyer, R. O., and Bierhuizen, J. F. (1964b). The influence of several transpiration suppressants on transpiration, photosynthesis, and water-use efficiency of cotton leaves. Aust. J. Biol. Sci. 17, 131-146.
- Slatyer, R. O., and Taylor, S. A. (1960). Terminology in plant- and soil-water relations. *Nature* (London) 187, 922-924.
- Slavik, B. (1974). "Methods of Studying Plant Water Relations." Springer-Verlag, Berlin.
- Smit, B., and Stachowiak, M. (1988). Effects of hypoxia and elevated carbon dioxide concentration on water flux through *Populus* roots. *Tree Physiol.* 4, 153–165.
- Smit, B., Stachowiak, M., and Van Volkenburgh, E. (1989). Cellular processes limiting leaf growth in plants under hypoxic root stress. J. Exp. Bot. 40, 89-94.
- Smith, P. G., and Dale, J. E. (1988). The effects of root cooling and excision treatments on the growth of primary leaves of *Phaseolus vulgaris* L. *New Phytol.* 110, 293-300.
- Smith, S., Weyers, J. D. B., and Berry, W. G. (1989). Variation in stomatal characteristics over the lower surface of Commelina communis leaves. Plant Cell Environ. 12, 653-659.
- Snyder, R. L. (1992). When water is limited how many acres do you plant? Calif. Agric. 46, 7-9.
- Sojka, R. E., and Stolzy, L. H. (1980). Soil-oxygen effects on stomatal response. Soil Sci. 130, 350–358.
- Sorrell, B. K. (1991). Transient pressure gradients in the lacunar system of the submerged macrophyte Egeria densa Planch. Aquatic Bot. 39, 99-108.
- Southwick, S. M., Shackel, K. A., Yeager, J. T., Asai, W. K., and Katacich, M., Jr. (1991). Over-tree sprinkling reduces abnormal shape in "Bing" sweet cheeries. *Calif. Agr.* 45, 24–26.
- Southwick, S. W., and Childers, N. S. (1941). Influence of Bordeaux mixture and its component parts on transpiration and apparent photosynthesis of apple leaves. *Plant Physiol.* 16, 721-754.
- Spalding, M. H., Spreitzer, R. J., and Ogren, W. L. (1983). Carbonic anhydrase-deficient mutant of *Chlamydomonas reinhardii* requires elevated carbon dioxide concentration for photoautotrophic growth. *Plant Physiol.* 73, 268–272.
- Spanner, D. C. (1951). The Peltier effect and its use in the measurement of suction pressure. J. Exp. Bot. 2, 145-168.
- Spanner, D. C. (1964). "Introduction to Thermodynamics." Academic Press, New York.
- Sperry, J. S., Donnelly, J. R., and Tyree, M. T. (1988a). Seasonal occurrence of xylem embolism in sugar maple. Am. J. Bot. 75, 1212-1218.
- Sperry, J. S., Holbrook, N. M., Zimmermann, M. H., and Tyree, M. T. (1987). Spring filling of xylem vessels in wild grapevine. *Plant Physiol.* 83, 414-417.
- Sperry, J. S, and Sullivan, J. E. M. (1992). Xylem embolism in response to freeze-thaw cycles and water stress in ring-porous, diffuse porous, and conifer species. *Plant Physiol.* **100**, 605–613.
- Sperry, J. S., Tyree, M. T., and Donnelly, J. R. (1988b). Vulnerability of xylem to embolism in a mangrove vs. an inland species of Rhizophoraceae. *Physiol. Plant.* 74, 276–283.
- Stahle, D. W., Cleaveland, M. K., and Hehr, J. G. (1988). North Carolina climate changes reconstructed from tree rings: A.D. 372 to 1985. Science 240, 1517–1519.
- Stålfelt, M. G. (1932). Der stomatäre Regulator in der pflanzlichen Transpiration. *Planta* 17, 22–85.
- Stälfelt, M. (1956a). Die stomatäre Transpiration und die Physiologie der Spaltöffnungen. *Encyl. Plant Physiol.* 3, 351–426. Springer-Verlag, Berlin.

- Stålfelt, M. G. (1956b). Morphologie und Anatomie des Blatter als Transpirationsorganen. *Encycl. Plant Physiol.* 3, 324–341. Springer-Verlag, Berlin.
- Stark, N., Spitzner, C., and Essig, D. (1985). Xylem sap analysis for determining nutritional status of trees: Pseudotsuga menziesii. Can. J. For. Res. 15, 429-437.
- Staswick, P. E. (1988). Soybean vegetative storage protein structure and gene expression. *Plant Physiol.* 87, 250-254.
- Staswick, P. E. (1989a). Correction. Plant Physiol. 89, 717.
- Staswick, P. E. (1989b). Preferential loss of an abundant storage protein from soybean pods during seed development. *Plant Physiol.* 90, 1252-1255.

- Staswick, P. E. (1989c). Developmental regulation and the influence of plant sinks on vegetative storage protein gene expression in soybean leaves. *Plant Physiol.* 89, 309-315.
- Steinberg, S. L., McFarland, M. J., and Worthington, J. W. (1990a). Comparison of trunk and branch sap flow with canopy transpiration in pecan. J. Exp. Bot. 41, 653-659.
- Steinberg, S. L., Miller, J. C., Jr., and McFarland, M. J. (1990b). Dry matter partitioning and vegetative growth of young peach trees under water stress. Aust. J. Plant Physiol. 17, 23-36.
- Steinberg, S. L., Van Bavel, C. H. M., and McFarland, M. J. (1989). A gauge to measure mass flow of sap in stems and trunks of woody plants. J. Am. Soc. Hort. Sci. 114, 466-472.
- Steudle, E. (1989). Water flow in plants and its coupling to other processes: An overview. *In* "Methods in Enzymology" (S. and B. Fleischer, eds.), Vol. 174, pp. 183–225. Academic Press, New York.
- Steudle, E., and Boyer, J. S. (1985). Hydraulic resistance to water flow in growing hypocotyl of soybean measured by a new pressure-perfusion technique. *Planta* 164, 189–200.
- Steudle, E., and Brinckmann, E. (1989). The osmometer model of the root: Water and solute relations of roots of *Phaseolus coccineus*. Bot. Acta 102, 85-95.
- Steudle, E., and Frensch, J. (1989). Osmotic responses of maize roots: Water and solute relations. *Planta* 177, 281-295.
- Steudle, E., and Jeschke, W. D. (1983). Water transport in barley roots. Planta 158, 237-248.
- Steudle, E., Lüttge, U., and Zimmermann, U. (1975). Water relations of the epidermal bladder cells of the halophytic species *Mesembryanthemum crystallinum*: Direct measurements of hydrostatic pressure and hydraulic conductivity. *Planta* 126, 229-246.
- Steudle, E., Muriman, M., and Peterson, C. A. (1993). Transport of water and solutes across maize roots modified by puncturing the endodermis. *Plant Physiol.* 103, 335–349.
- Steudle, E., Oren, R., and Schulze, E.-D. (1987). Water transport in maize roots: Measurement of hydraulic conductivity, solute permeability, and of reflection coefficients of excised roots using the root pressure probe. *Plant Physiol.* 84, 1220–1232.
- Steudle, E., Smith, J., and Lüttge, U. (1980). Water-relation parameters of individual mesophyll cells of the Crassulacean acid metabolism plant *Kalanchoe daigremontiana*. *Plant Physiol.* 66, 1155–1163.
- Steudle, E., and Tyerman, S. D. (1983). Determination of permeability coefficients, reflection coefficients, and hydraulic conductivity of *Chara corallina* using the pressure probe: Effects of solute concentrations. *J. Membr. Biol.* 75, 85–96.
- Steudle, E., Ziegler, H., and Zimmermann, U. (1983). Water relations of the epidermal bladder cells of Oxalis carnosa Molina. Planta 159, 38-45.
- Steudle, E., and Zimmermann, U. (1974). Determination of the hydraulic conductivity and of refection coefficients in *Nitella flexilis* by means of direct cell-turgor pressure measurements. *Biochim. Biophys. Acta* 332, 399-412.
- Stevens, C. L., and Eggert, R. L. (1945). Observations on the causes of flow of sap in red maple. Plant Physiol. 20, 636-648.
- Steward, F. C., and Sutcliffe, J. F. (1959). Plants in relation to inorganic salts. *In* "Plant Physiology" (F. C. Steward, ed.), Vol. 2, pp. 253-478. Academic Press, New York.
- Stewart, D. A., and Nielsen, D. R., eds. (1990). "Irrigation of Agricultural Crops." Agron. Mon. 30, American Society of Agronomy, Madison, WI.
- Stillinger, F. H. (1980). Water revisited. Science 209, 451-457.
- Stolzy, L. H., Focht, D. D., and Fluehler, H. (1981). Indications of soil aeration. Flora 171, 136-265
- Stone, E. C., and Fowells, H. A. (1955). The survival value of dew as determined under laboratory conditions. I. *Pinus ponderosa. For. Sci.* 1, 183–188.
- Stone, E. C., and Norberg, E. A. (1979). Root growth capacity: One key to bare root survival. *Calif. Agric.* 33, 14-15.
- Stone, J. E., and Stone, E. L. (1975a). Water conduction in lateral roots of red pine. For. Sci. 21, 53-60.

- Stone, J. E., and Stone, E. L. (1975b). The communal root system of red pine: Water conduction through root grafts. For. Sci. 21, 255-262.
- Strasburger, E. (1891). Ueber den Bau und die Verrichtungen der Leitungsbahnen in der Pflanzen. Histol. Beitr. 3, 849-877.
- Strogonov, B. P. (1964). "Physiological Basis of Salt Tolerance of Plants." English translation by A. Poljakoff-Mayber and A. M. Mayer. Israel Program for Sci. Translations, Jerusalem, Oldbourne Press, London.
- Suhayda, C. G., and Goodman, R. N. (1981). Early proliferation and migration and subsequent xylem occlusion by *Erwinia amylovora* and the fate of its extracellular polysaccharide (EPS) in apple shoots. *Phytopathology* 71, 697–707.
- Sumner, D. R. (1982). Crop rotation and plant productivity. In "Handbook of Agricultural Productivity" (M. Rechcigl, Jr. ed.), Vol. 1, pp. 273-313. CRC Press, Boca Raton, FL.
- Sung, F. J. M., and Krieg, D. R. (1979). Relative sensitivity of photosynthetic assimilation and translocation of ¹⁴Carbon to water stress. *Plant Physiol.* 64, 852–856.
- Sureshi, K. K., and Rai, R. V. S. (1988). Allelopathic exclusion of understorey by a few multipurpose trees. *Int. Tree Crops J.* 5, 143–151.
- Surowy, T. K., and Boyer, J. S. (1991). Low water potentials affect expression of genes encoding vegetative storage proteins and plasma membrane proton ATPase in soybean. *Plant Mol. Biol.* 16, 251-262.
- Sutton, R. F. (1969). "Form and Development of Conifer Root systems." Tech. Commun. No. 7, Commonwealth Forestry Bureau, Oxford, UK.
- Svenningsson, H., and Liljenberg, C. (1986). Membrane lipid changes in root cells of rape (*Brassica napus*) as a function of water deficit stress. *Physiol. Plant.* 68, 53-58.
- Svenson, S. E., and Davies, F. T., Jr. (1992). Comparison of methods for estimating surface area of water-stressed and fully hydrated pine needle segments for gas exchange analysis. *Tree Physiol*. 10, 417-421.
- Swank, W. T., and Douglas, J. E. (1974). Streamflow greatly reduced by converting hardwood stands to pine. *Science* 185, 857–859.
- Swanson, C. A. (1943). Transpiration in American holly in relation to leaf structure. *Ohio J. Sci.* 43, 43-46.
- Sylvia, D. M., Hammond, L. C., Bennett, J. M., Haas, J. H., and Linda, S. B. (1993). Field response of maize to a VAM fungus and water management. *Agron. J.* 85, 193-198.
- Syvertsen, J. P., and Graham, J. H. (1990). Influence of vesicular arbuscular mycorrhizae and leaf age on net gas exchange of *Citrus* leaves. *Plant Physiol.* 94, 1424–1428.
- Taiz, L. (1984). Plant cell expansion: Regulation of cell wall mechanical properties. Annu. Rev. Plant Physiol. 35, 585-657.
- Taiz, L., Métraux, J.-P., and Richmond, P. A. (1981). Control of cell expansion in the Nitella internode. In "Cell Biology Monographs, Vol. 8: Cytomorphogenesis in Plants" (O. Kiermayer, ed.), pp. 231–264. Springer, Wien.
- Takahashi, H., and Scott, T. (1991). Hydrotropism and its interaction with gravitropism in maize roots. *Plant Physiol.* 96, 558-564.
- Tal, M. (1966). Abnormal stomatal behavior in wilty mutants of tomato. *Plant Physiol.* 41, 1387–1391.
- Talboys, P. W. (1978). Dysfunction of the water system. In "Plant Disease" (J. G. Horsfall and E. B. Cowling, eds.), Vol. 3, pp. 141–162. Academic Press, New York.
- Tanford, C. (1963). The structure of water and aqueous solutions. In "Temperature: Its Measurement and Control in Science and Industry" (C. M. Herzfeld, ed.), Vol. 3, pp. 123–129. Reinhold Publishing Corp., New York.
- Tanford, C. (1980). "The Hydrophobic Effect." Wiley, New York.
- Tang, P. S., and Wang, J. S. (1941). A thermodynamic formulation of the water relations in an isolated living cell. J. Physical Chem. 45, 443-453.

- Tanner, W., and Beevers, H. (1990). Does transpiration have an essential function in long-distance ion transport in plants? *Plant Cell Environ.* 13, 745-750.
- Tarczynski, M. C., Jensen, R. G., and Bohnert, H. J. (1993). Stress protection of transgenic tobacco by production of the osmolyte mannitol. *Science* 259, 508-510.
- Tardieu, F. (1988). Analysis of spatial variability in maize root density. III. Effect of a wheel compaction on water extraction. *Plant Soil* 109, 257-262.
- Tardieu, F., Katerji, N., Bethenod, O., Zhang, J., and Davies, W. J. (1991). Maize stomatal conductance in the field: Its relationship with soil and plant water potentials, mechanical constraints and ABA concentration in the xylem sap. *Plant Cell Environ.* 14, 121-126.
- Taylor, H. M., Burnett, E., and Booth, G. D. (1978). Taproot elongation rates of soybeans. Z. Acker. Pflanzenbau. 146, 33-39.
- Taylor, H. M., Jordan, W. R., and Sinclair, T. R. (1983). "Limitations to Efficient Water Use in Crop Production." American Society of Agronomy, Madison, WI.
- Taylor, H. M., and Klepper, B. (1975). Water uptake by cotton root systems: An examination of assumptions in the single root model. Soil Sci. 120, 57-67.
- Taylor, H. M., and Ratliff, L. F. (1969). Root elongation rates of cotton and peanuts as a function of soil strength and soil water content. Soil Sci. 108, 113-119.
- Taylor, H. M., and Terrell, E. E. (1982). Rooting pattern and plant productivity. In "Handbook of Agricultural Productivity" (M. Rechcigl, Jr., ed.), Vol. 1, pp. 185-200. CRC Press, Boca Raton, FL.
- Taylor, H. M., and Willatt, S. T. (1983). Shrinkage of soybean roots. Agron. J. 75, 818-820.
- Teare, I. D., and Peet, M. M. (eds.) (1983). "Crop Water Relations." Wiley, New York.
- Tepfer, M., and Taylor, I. E. P. (1981). The permeability of plant cell walls as measured by gel filtration chromatography. *Science* 213, 761-763.
- Terashima, I. (1992). Anatomy of non-uniform leaf photosynthesis. Photosynthesis Res. 31, 195-212.
- Terashima, I., Wong, S.-C., Osmond, C. B., and Farquhar, G. D. (1988). Characterisation of non-uniform photosynthesis induced by abscisic acid in leaves having different mesophyll anatomies. *Plant Cell Physiol.* 29, 385–394.
- Terry, N., Waldron, L. J., and Ulrich, A. (1971). Effects of moisture stress on the multiplication and expansion of cells in leaves of sugar beet. *Planta* 97, 281–289.
- Tesar, M. B. (1993). Delayed seeding of alfalfa avoids autotoxicity after plowing or glyphosate treatment of established stands. *Agron. J.* 85, 256-263.
- Teskey, R. O., Grier, C. C., and Hinckley, T. M. (1985). Relations between root system size and water inflow capacity of *Abies amabilis* growing in a subalpine forest. *Can. J. For. Res.* 15, 669–672.
- Teskey, R. O., and Hinckley, T. M. (1981). Influence of temperature and water potential on root growth of white oak. *Physiol. Plant.* **52**, 363–369.
- Teviotdale, B. L., Davis, R. M., Guerard, J. P., and Harper, D. H. (1990). Method of irrigation affects sour skin rot of onion. Calif. Agric. 44, 27-28.
- Thielmann, J., Tolbert, N. E., Goyal, A., and Senger, H. (1990). Two systems for concentrating CO₂ and bicarbonate during photosynthesis by *Scenedesmus Plant Physiol.* 92, 622–629.
- Thoday, D. (1918). On turgescence and the absorption of water by the cells of plants. *New Phytol.* 17, 108–113.
- Thomas, J. C., and Bohnert, H. J. (1993). Salt stress perception and plant growth regulators in the halophyte Mesembryanthemum crystallinum. Plant Physiol. 103, 1299–1304.
- Thomas, R. B., and Strain, B. R. (1991). Root restriction as a factor in photosynthetic acclimation of cotton seedlings grown in elevated carbon dioxide. *Plant Physiol.* **96**, 627–634.
- Thomas, W. A. (1967). Dye and calcium ascent in dogwood trees. Plant Physiol. 42, 1800-1802.
- Thompson, A. C., ed. (1985). "The Chemistry of Allelopathy," ACS Symp. 268. Am. Chem. Soc. Washington, D.C.

- Thomson, C. J., and Greenway, H. (1991). Metabolic evidence for stelar anoxia in maize roots exposed to low O₂ concentrations. *Plant Physiol.* 96, 1294-1301.
- Thornley, J. H. M. (1972). A balanced quantitative model for root: shoot ratios in vegetative plants. *Ann. Bot.* 36, 431-441.
- Thornthwaite, C. W., and Mather, J. R. (1957). Instructions and tables for computing potential evapotranspiration and the water balance. Drexel Inst. Technol. Lab. Climatology, Publ. Climatol. 10, 181–311.
- Thut, H. F. (1932). The movement of water through some submerged plants. Am. J. Bot. 19, 693-709.
- Tiefer, M. A., Roy, H., and Moudrianakis, E. N. (1977). Binding of adenine nucleotides and pyrophosphate by the purified coupling factor of photophosphorylation. *Biochemistry* 16, 2396–2404.
- Ting, I. P. (1985). Crassulacean acid metabolism. Annu. Rev. Plant Physiol. 36, 595-622.
- Ting, I. P., and Loomis, W. E. (1965). Further studies concerning stomatal diffusion. *Plant Physiol.* 40, 220-228.
- Tinker, P. B. (1976). Roots and water: Transport of water to plant roots in soil. *Phil. Trans. Roy. Soc. London Ser. B* 273, 445-461.
- Tjepkema, J. D., Schwintzer, C. R., and Benson, D. R. (1986). Physiology of actinorhizal nodules. Annu. Rev. Plant Physiol. 37, 209-232.
- Todd, G. W., and Webster, D. L. (1965). Effects of repeated drought periods on photosynthesis and survival of cereal seedlings. Agron. J. 57, 399-404.
- Tomos, A. D., Steudle, E., Zimmermann, U., and Schulze, E.-D. (1981). Water relations of leaf epidermal cells of *Tradescantia virginiana*. Plant Physiol. 68, 1135-1143.
- Topp, G. C., and Davis, J. L. (1985). Measurement of soil water content using time domain reflectometry (TDR): A field evaluation. Soil Sci. Soc. Am. J. 49, 19-24.
- Torrey, J. G., and Clarkson, D. T., eds. (1975). "The Development and Function of Roots." Academic Press, New York.
- Tranquillini, W. (1969). Photosynthese und Transpiration einiger Holzarten ber verschieden starkem Wind. Centralbl. Gesamte Forsteve. 85, 43-49.
- Transeau, E. N. (1905). Forest centers of eastern North America. Am. Nat. 39, 875-889.
- Traube, M. (1867). Experimente zur Theorie der Zellbildung und Endosmose. Archiv. Anat. Physiol. wiss Medecin 87, 165.
- Trejo, C. L., Davies, W. J., and Ruiz, L. M. P. (1993a). Sensitivity of stomata to abscisic acid: An effect of the mesophyll. *Plant Physiol.* 102, 497-502.
- Trejo, C. L., Gowing, D. J. G., and Davies, W. J. (1993b). Control of leaf growth and physiology: A link between climatic and edaphic effects. In "Plant Responses to Cellular Dehydration during Environmental Stress" (T. J. Close and E. A. Bray, eds.), pp. 48–56. American Society of Plant Physiologists, Rockville, MD.
- Trewayas, A. (1981). How do plant growth substances work? Plant Cell Environ. 4, 203-228.
- Tripp, K. E., Peet, M. M., Pharr, D. M., Willits, D. H., and Nelson, P. V. (1991). CO₂-enhanced yield and foliar deformation among tomato genotypes in elevated CO₂ environments. *Plant Physiol.* 96, 713-719.
- Troughton, J., and Donaldson, L. A. (1981). "Probing Plant Structure." McGraw-Hill, New York. Tsukahara, H., and Kozlowski, T. T. (1985). Importance of adventitious roots to growth of flooded
- Platanus occidentalis seedlings. Plant Soil 88, 123-132.
- Tubbs, F. R. (1973). Research field in the interaction of rootstocks and scions in woody perennials. Parts I and II. *Hort. Abstr.* 43, 247–253, 325–335.
- Tukey, H. B., Jr., Mecklenburg, R. A., and Morgan, J. V. (1965). A mechanism for the leaching of metabolites from foliage. *In* "Isotopes and Radiation in Soil-Plant Nutrition Studies," pp. 371– 385. IAEA, Vienna.

- Turner, L. M. (1936). Root growth of seedlings of *Pinus echinata* and *Pinus taeda. J. Agric. Res.* (Washington, D.C.) 53, 145-149.
- Turner, N. C. (1970). Speeding the drying of alfalfa hay with fusicoccin. Agron. J. 62, 538-541.
- Turner, N. C. (1986). Crop water deficits: A decade of progress. Adv. Agron. 39, 1-51.
- Turner, N. C., Begg, J. E., Rawson, H. M., English, S. D., and Hearn, A. B. (1978). Agronomic and physiological responses of soybean and sorghum crops to water deficits. III. Components of water potential, leaf conductance, ¹⁴CO₂ photosynthesis, and adaptation to water deficits. Aust. J. Plant Physiol. 5, 179–194.
- Turner, N. C., and Kramer, P. J., eds. (1980). "Adaptation of Plants to Water and High Temperature Stress." Wiley, New York.
- Turner, N. C., Schulze, E.-D., and Gollan, T. (1985). The responses of stomata and leaf gas exchange to vapour pressure deficits and soil water contents. II. In the mesophytic herbaceous species *Helianthus annuus*. Oecologia 65, 348-355.
- Turrell, F. M. (1936). The area of the internal exposed surface of dicotyledon leaves. Am. J. Bot. 23, 255-264.
- Tyerman, S. D., and Steudle, E. (1982). Comparisons between osmotic and hydrostatic water flows in a higher plant cell: Determination of hydraulic conductivities and reflection coefficients in isolated epidermis of *Tradescantia virginiana*. Aust. J. Plant Physiol. 9, 461–480.
- Tyree, M. T. (1973). An alternative explanation for the apparently active water exudation in excised roots. J. Exp. Bot. 24, 33-37.
- Tyree, M. T., Dixon, M. A., Tyree, E. L., and Johnson, R. (1984). Ultrasonic acoustic emissions from the sapwood of cedar and hemlock: An examination of three hypotheses concerning cavitation. *Plant Physiol.* 75, 988-992.
- Tyree, M. T., and Ewers, F. W. (1991). The hydraulic architecture of trees and other woody plants. New Phytol. 119, 345-360.
- Tyree, M. T., Fiscus, E. L., Wullschlegel, S. D., and Dixon, M. A. (1986). Detection of xylem cavitation in corn under field conditions. *Plant Physiol.* 82, 597–599.
- Tyree, M. T., Snyderman, D. A., Wilmot, T. R., and Machado, J.-L. (1991). Water relations and hydraulic architecture of a tropical tree (*Schefflera morototoni*). *Plant Physiol.* 96, 1105–1113.
- Tyree, M. T., and Sperry, J. S. (1988). Do woody plants operate near the point of catastrophic xylem dysfunction caused by dynamic water stress? Answers from a model. *Plant Physiol.* 88, 574– 580.
- Tyree, M. T., and Sperry, J. S. (1989). Vulnerability of xylem to cavitation and embolism. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 40, 19–38.
- Tyree, M. T., and Yang, S. (1992). Hydraulic conductivity recovery versus water pressure in xylem of *Acer saccharum*. *Plant Physiol.* **100**, 669-676.
- Tyree, M. T., and Yianoulis, P. (1980). The site of water evaporation from sub-stomatal cavities, liquid path resistances and hydroactive stomatal closure. *Ann. Bot.* (London) **46**, 175–193.
- U.S. Department of Agriculture (1965). Losses in Agriculture. Agriculture Handbook No. 291. Government Printing Office, Washington, DC.
- U.S. Department of Agriculture (1979). Agricultural Statistics. Government Printing Office, Washington, DC.
- U.S. Department of Agriculture, Soil Conservation Service (1975). Soil Taxonomy. Government Printing Office, Washington DC.
- U.S. Department of the Interior (1977). Estimated Use of Water in the United States in 1975. U.S. Geol. Surv. Circ. No. 765.
- Unrath, C. R. (1972). The quality of "Red Delicious" apples as affected by overtree sprinkler irrigation. *J. Am. Soc. Hort. Sci.* 97, 58-61.
- Upchurch, D. R., and Ritchie, J. T. (1988). Root observations using a video recording system in mini-rhizotrons. Agron. J. 75, 1009-1015.

- Ursprung, A. (1929). The osmotic quantities of the plant cell. Int. Bot. Congr. Proc. 4th, Vol. 2, 1081-1094.
- Ursprung, A., and Blum, G. (1916). Zur Methode der Saugkraftmessung. Ber. Deut. Bot. Ges. 34, 525-539.
- Ussing, H., H. (1953). Transport through biological membranes. Annu. Rev. Physiol. 15, 1-20.
- Vaadia, Y. (1960). Autonomic diurnal fluctuations in rate of exudation and root pressure of decapitated sunflower plants. *Physiol. Plant.* 13, 701–717.
- Vaclavik, J. (1966). The maintaining of constant soil moisture levels lower than maximum capillary capacity in pot experiments. *Biol. Plant.* (Prague) 8, 80-85.
- Van Alfen, N. K., and Turner, N. C. (1975). Changes in alfalfa stem conductance induced by Corynebacterium insidiosum toxin. Plant Physiol. 55, 559-561.
- Van As, H., and Schaafsma, T. J. (1984). Noninvasive measurement of plant water flow by nuclear magnetic resonance. *Biophys. J.* 45, 469-472.
- Van Bavel, C. H. M. (1966). Potential evaporation: the combination concept and its experimental verification. Water Resour. Res. 2, 455-468.
- Van Bavel, C. H. M. (1967). Changes in canopy resistance to water loss from alfalfa induced by soil water depletion. *Agric. Meterol.* 4, 165–176.
- Van Bavel, C. H. M., and Ehrler, W. L. (1968). Water loss from a sorghum field and stomatal control. Agron. I. 60, 84-86.
- Van Bavel, C. H. M., Fritschen, L. J., and Lewis, W. E. (1963). Transpiration by Sudangrass as an externally controlled process. *Science* 141, 269-270.
- Van Bavel, C. H. M., and Verlinden, F. J. (1956). "Agricultural Drought in North Carolina." North Carolina Agric. Exp. Stn. Tech. Bull. 122.
- Van der Post, C. J. (1968). Simultaneous observations on root and top growth. Acta Hort. 7, 138–144.
- van Eijk, M. (1939). Analyze der Wirkung des NaCl auf dis Entwicklung, Sukkulenz und Transpiration bei Salicornia herbacea, sowie Untersuchungen über den Einluss der Salzaufnahme auf die Wurzelatmung bei Aster tripolium. Red. Trav. Bot. Neerl. 36, 559-657.
- Van Gardingen, P. R., Grace, J., and Jeffree, C. E. (1991). Abrasive damage by wind to the needle surfaces of *Picea sitchensis* (Bong.) Carr. and *Pinus sylvestris* L. *Plant Cell Environ*. 14, 185– 193.
- Van Gardingen, P. R., Jeffree, C. E., and Grace, J. (1989). Variation in stomatal aperture in leaves of Avena fatua L. observed by low-temperature scanning electron microscopy. Plant Cell Environ. 12, 887-898.
- Van Noordwijk, M., and Brouwer, G. (1988). Quantification of air-filled root porosity: A comparison of two methods. *Plant Soil* 111, 255-258.
- Van Overbeek, J. (1942). Water uptake by excised root systems of the tomato due to nonosmotic forces. Am. J. Bot. 29, 677-683.
- Van Rees, J. C. J., and Comerford, N. B. (1990). The role of woody roots of slash pine seedlings in water and potassium absorption. *Can. J. For. Res.* 20, 1183–1191.
- Van Volkenburgh, E., and Boyer, J. S. (1985). Inhibitory effects of water deficit on maize leaf elongation. *Plant Physiol.* 77, 190-194.
- Van Volkenburgh, E., and Davies, W. J. (1977). Leaf anatomy and water relations of plants grown in controlled environments and in the field. Crop Sci. 17, 353-358.
- Vance, C. P., Heichel, G. H., Barnes, D. K., Bryan, J. W., and Johnson, L. F. (1979). Nitrogen fixation, nodule development, and vegetative regrowth of alfalfa (*Medicago sativa L.*) following harvest. *Plant Physiol.* 64, 1–8.
- Vanderhoef, L. N., Findley, J. S., Burke, J. J., and Blizzard, W. E. (1977a). Auxin has no effect on modification of external pH by soybean hypocotyl cells. *Plant Physiol.* **59**, 1000–1003.
- Vanderhoef, L. N., Shen Lu, T.-Y., and Williams, C. (1977b). Comparison of auxin-induced and acid-induced elongation in soybean hypocotyl. *Plant Physiol.* 59, 1004-1007.

- Vanderhoef, L. N., Stahl, C. A., Williams, C. A., and Brinkmann, K. A. (1976). Additional evidence for separable responses to auxin in soybean hypocotyl. *Plant Physiol.* 57, 817–819.
- Vartanian, N. (1981) Some aspects of structural and functional modifications induced by drought in root systems. *Plant Soil* 63, 83–92.
- Vartanian, N., Marcotte, L., and Giraudat, J. (1994). Drought rhizogenesis in *Arabidopsis thaliana Plant Physiol.* 104, 761–767.
- Vegelin, S. J., White, I., and Jenkins, D. R. (1990). Improved field probes for soil water content and electrical conductivity measurements using time domain reflectometry. Water Resour. Res. 25, 2367-2376.
- Veihmeyer, F. J. (1927). Some factors affecting the irrigation requirements of deciduous orchards. Hilgardia 2, 125-284.
- Veihmeyer, F. J., and Hendrickson, A. H. (1928). Soil moisture at permanent wilting of plants. *Plant Physiol.* 3, 355-357.
- Veihmeyer, F. J., and Hendrickson, A. H. (1938). Soil moisture as an indication of root distribution in deciduous orchards. *Plant Physiol.* 13, 169–177.
- Veihmeyer, F. J., and Hendrickson, A. H. (1950). Soil moisture in relation to plant growth. *Annu. Rev. Plant Physiol.* 1, 285-304.
- Veres, J. S., Johnson, G. A., and Kramer, P. J. (1991). In vivo magnetic resonance imaging of Blechnum ferns: Changes in T1 and N(H) during dehydration and rehydration. Am. J. Bot. 78, 80-88.
- Vertucci, C. W. (1989). The effects of low water contents on physiological activities of seeds. Physiol. Plant. 77, 172-176.
- Vertucci, C. W., and Leopold, A. C. (1987a). Water binding in legume seeds. *Plant Physiol.* 85, 224-231.
- Vertucci, C. W., and Leopold, A. C. (1987b). The relationship between water binding and desiccation tolerance in tissues. *Plant Physiol.* 85, 232–238.
- Vertucci, C. W., and Roos, E. E. (1990). Theoretical basis of protocols for seed storage. Plant Physiol. 94, 1019–1023.
- Vesque, M. J. (1884). Mouvement de la sève ascendante. *Ann. Sci. Naturelles*, VI Series, Tome XIX, 159-199.
- Vessey, J. K., Raper, C. D., Jr., and Henry, L. T. (1990). Cyclic variations in nitrogen uptake rate in soybean plants: Uptake during reproductive growth. *J. Exp. Bot.* 41, 1579–1584.
- Vieira da Silva, J. V., Naylor, A. W., and Kramer, P. J. (1974). Some ultrastructural and enzymatic effects of water stress in cotton (Gossypium hirsutum L.) leaves. Proc. Natl. Acad. Sci. USA 71, 3243-3247.
- Viets, F. G., Jr. (1972). Water deficits and nutrient availability. *In* "Water Deficits and Plant Growth" (T. T. Kozlowski, eds.), Vol. 4, pp. 217–239. Academic Press, New York.
- Voesenek, L. A. C. J., Banga, M., Thier, R. H., Mudde, C. M., Harren, F. J. M., Barendse, G. W. M., and Blom, C. W. P. M. (1993). Submergence-induced ethylene synthesis, entrapment, and growth in two plant species with contrasting flooding resistances. *Plant Physiol.* 103, 783–791.
- Voetberg, G. S., and Sharp, R. E. (1991). Growth of the maize primary root at low water potentials. III. Role of increased proline deposition in osmotic adjustment. *Plant Physiol.* 96, 1125–1130.
- Vogel, S. (1981). "Life in Moving Fluids." Princeton University Press, Princeton, New Jersey.
- Vogel, S. (1989). Drag and reconfiguration of broad leaves. J. Exp. Bot. 40, 941-948.
- Volpin, H., Elkind, Y., Okon, Y., and Kapulnik, Y. (1994). A vesicular arbuscular mycorrhizal fungus (Glomus intraradix) induces a defense response in alfalfa roots. Plant Physiol. 104, 683–689.
- Wadleigh, C. H. (1946). The integrated soil moisture stress upon a root system in a large container of saline soil. Soil Sci. 61, 225-238.
- Wadleigh, C. H., and Ayers, A. D. (1945). Growth and biochemical composition of bean plants as conditioned by soil moisture tension and salt concentration. *Plant Physiol.* 20, 106–132.

- Wadleigh, C. H., Gauch, H. G., and Magistad, O. C. (1946). "Growth and Rubber Accumulation in Guayule as Conditioned by Soil Salinity and Irrigation Regime." U.S. Dept. Agric. Tech. Bull 925.
- Waisel, V., Eshel, A., and Kafkafi, U., eds. (1991). "Plant Roots." Dekker, New York.
- Walker, D. A., and Zelitch, I. (1963). Some effects of metabolic inhibitors, temperature, and anaerobic conditions on stomatal movement. *Plant Physiol.* 38, 390–396.
- Walker, R. F., West, D. C., McLaughlin, S. B., and Amundsen, C. C. (1989). Growth, xylem pressure potential, and nutrient absorption of loblolly pine on a reclaimed surface mine as affected by an induced *Pisolithus tinctorios* infection. For. Sci. 35, 569-581.
- Walker, R. R. (1986). Sodium exclusion and potassium-sodium selectivity in salt-treated trifoliate orange (*Poncirus trifoliata*) and Cleopatra mandarin (*Citrus reticulata*) plants. *Aust. J. Plant Physiol.* 13, 293-303.
- Walsh, K. B., Vessey, J. K., and Layzell, D. B. (1987). Carbohydrate supply and N₂ fixation in soybean: The effect of varied daylength and stem girdling. *Plant Physiol.* 85, 137–144.
- Walter, H. D. (1931). "Die Hydratur der Pflanze und ihre physiologische-ökologische Bedeutung," pp. 118-121. G. Fischer, Jena.
- Walter, H. D. (1965). Klarung des spasifischerr Wasserzustandes in Plasma. Ber. Dtsch. Bot. Ges. 78, 104-114.
- Walton, D. C. (1980). Biochemistry and physiology of abscisic acid. Annu. Rev. Plant Physiol. 31, 453–489.
- Wang, J., Hesketh, J. D., and Woolley, J. T. (1986). Preexisting channels and soybean rooting patterns. Soil Sci. 141, 432-437.
- Ward, D. A., and Bunce, J. A. (1986). Novel evidence for a lack of water vapour saturation within the intracellular airspace of turgid leaves of mesophytic species. J. Exp. Bot. 37, 504-516.
- Wardlaw, I. F. (1967). The effect of water stress on translocation in relation to photosynthesis and growth. I. Effects during grain development in wheat. Aust. J. Biol. Sci. 20, 25-39.
- Wareing, P. F., and Phillips, I. D. J. (1981). "Growth and Differentiation in Plants," 3rd Ed. Pergamon Press, New York.
- Waring, R. H., and Running, S. W. (1978). Sapwood and water storage: Its contribution to transpiration and effect on water conductance through the stems of old-growth Douglas-fir. *Plant Cell Environ.* 1, 131–140.
- Waring, R. H., and Schlesinger, W. H. (1985). "Forest Ecosystems: Concepts and Management." Academic Press, Orlando, FL.
- Waring, R. H., Whitehead, D., and Jarvis, P. G. (1979). The contribution of stored water to transpiration in Scot Pine. Can. J. For. Res. 10, 555-558.
- Waters, I., Armstrong, W., Thompson, C. J., Setter, T. L., Adkins, S., Gibbs, J., and Greenway, H. (1989). Diurnal changes in radial oxygen loss and ethanol metabolism in roots of submerged and non-submerged rice seedlings. *New Phytol.* 113, 439-451.
- Waters, I., Kuiper, P. J. C., Watkins, E., and Greenway, H. (1991). Effects of anoxia on wheat seed-lings. I. Interaction between anoxia and other environmental factors. J. Exp. Bot. 42, 1427–1435.
- Watson, B. T., and Wardlaw, I. F. (1981). Metabolism and export of 14C-labelled photosynthate from water-stressed leaves. *Aust. J. Plant. Physiol.* 8, 143-153.
- Weatherley, P. E. (1982). Water uptake and flow in roots. In "Encyclopedia of Plant Physiology" (O. L. Lange, P. S. Nobel, C. B. Osmond, H. Ziegler, eds.), Vol. 12B, pp. 70–109. Springer, Berlin/Heidelberg/New York.
- Weatherspoon, C. P. (1968). "The Significance of the Mesophyll Resistance in Transpiration." Ph.D. Dissert., Duke University, Durham, NC.
- Weaver, J. E. (1919). The ecological relations of roots. Carnegie Inst. Washington Publ. 286.
- Weaver, J. E. (1920). Root development in the grassland formation. Canegie Inst. Washington Publ. 292.

- Weaver, J. E. (1925). Investigations on the root habits of plants. Am. J. Bot. 12, 502-509.
- Weaver, J. E. (1926). "Root Development of Field Crops." McGraw-Hill, New York.
- Weaver, J. E., and Bruner, W. E. (1927). "Root Development of Vegetable Crops." McGraw-Hill, New York.
- Weaver, J. E., and Clements, F. E. (1938). "Plant Ecology," 2nd Ed., McGraw-Hill, New York.
- Weaver, J. E., and Zink, E. (1946). Length of life of roots of ten species of perennial range and pasture grasses. *Plant Physiol.* 21, 201–217.
- Webb, L. J., Tracey, J. G., and Haydock, K. P. (1967). A factor toxic to seedlings of the same species associated with living roots of the non-gregarious rain forest tree *Guevillea robusta*. J. Appl. Ecol. 4, 13-25.
- Weisz, P. R., Denison, R. F., and Sinclair, T. R. (1985). Response to drought stress of nitrogen fixation (acetylene reduction) rates by field-grown soybeans. *Plant Physiol.* 78, 525-530.
- Weisz, P. R., and Sinclair, T. R. (1987). Regulation of soybean nitrogen fixation in response to rhizosphere oxygen. II. Quantification of nodule gas permeability. *Plant Physiol.* 84, 906-910.
- Welbaum, G. E., and Bradford, K. J. (1988). Water relations of seed development and germination in muskmelon (*Cucumis melo L.*). *Plant Physiol.* 86, 406-411.
- Wenger, K. F. (1955). Light and mycorrhiza development. Ecology 36, 518-520.
- Wenkert, W. (1980). Measurement of tissue osmotic pressure. Plant Physiol. 65, 614-617.
- Went, F. W. (1943). Effect of the root system on tomato stem growth. Plant Physiol. 18, 51-65.
- Went, F. W. (1975). Water vapor absorption in *Prosopis. In* "Physiological Adaptation to the Environment" (F. J. Vernberg, ed.), pp. 67-75. Intext Educational Publications, New York.
- Westgate, M. E., and Boyer, J. S. (1984). Transpiration- and growth-induced water potentials in maize. *Plant Physiol.* 74, 882-889.
- Westgate, M. E., and Boyer, J. S. (1985a). Carbohydrate reserves and reproductive development at low water potentials in maize. *Crop Sci.* 25, 762–769.
- Westgate, M. E., and Boyer, J. S. (1985b). Osmotic adjustment and the inhibition of leaf, root, stem and silk growth at low water potentials in maize. *Planta* 164, 540–549.
- Westgate, M. E., and Boyer, J. S. (1986a). Silk and pollen water potentials in maize. *Crop Sci.* 26, 947-51.
- Westgate, M. E., and Boyer, J. S. (1986b). Reproduction at low silk and pollen water potentials in maize. *Crop Sci.* 26, 951-956.
- Westgate, M. E., and Boyer, J. S. (1986c). Water status of the developing grain of maize. Agron. J. 78, 714-719.
- Westgate, M. E., and Steudle, E. (1985). Water transport in the midrib tissue of maize leaves. *Plant Physiol.* 78, 183-191.
- Westgate, M. E., and Thomson Grant, D. L. (1989). Water deficits and reproduction in maize: Response of the reproductive tissue to water deficits at anthesis and mid-grain fill. *Plant Physiol.* 91, 862–867.
- Weyers, J. D. B., and Johansen, L. G. (1985). Accurate estimation of stomatal aperture from silicone rubber impressions. *New Phytol.* 101, 109–115.
- Weyers, J. D. B., and Meidner, H. (1990). "Methods of Stomatal Research." Longman Scientific and Technical, New York.
- White, J. W., and Castillo, J. A. (1989). Relative effect of roots and shoot genotypes on yield of common bean under drought stress. Crop Sci. 29, 360-362.
- White, J. W., and Mastalerz, J. W. (1966). Soil moisture as related to container capacity. *Proc. Am. Soc. Hort. Sci.* 89, 758–768.
- White J. W. C. (1989). Stable hydrogen isotopes in plants: A review of current theory and some potential applications. *Ecol. Studies* 68, 142-162.
- White, J. W. C., Cook, E. R., Lawrence, J. R., and Broecker, W. S. (1985). The D/H ratio of sap in trees: Implications for water sources and tree ring D/H ratios. *Geochim. Cosmochim. Acta* 49, 237-246.

- White, L. M., and Ross, W. H. (1939). Effect of various grades of fertilizers on the salt content of the soil solution. J. Agr. Res. 59, 81-100.
- White, P. R. (1938). "Root-pressure": An unappreciated force in sap movement. Am. J. Bot. 25, 223-227.
- White P. R., Schuker, E., Kern, J. R., and Fuller, F. H. (1958). "Root pressure" in gymnosperms. Science 128, 308-309.
- Whitehead, D., Edwards, W. R. N., and Jarvis, P. G. (1984). Conducting sapwood area, foliage area, and permeability in mature trees of *Picea sitchensis* and *Pinus contorta. Can. J. For. Res.* 14, 940-947.
- Whitehead, D., and Hinckley, T. M. (1991). Models of water flux through forest stands: Critical leaf and stand parameters. *Tree Physiol.* 9, 35-57.
- Whitehead, D., and Kelliher, F. M. (1991a). A canopy water balance model for a *Pinus radiata* stand before and after thinning. *Agric. For. Meteorol.* 55, 109–126.
- Whitehead, D., and Kelliher, F. M. (1991b). Modeling the water balance of a small *Pinus radiata* catchment. *Tree Physiol.* 9, 17-33.
- Whiteman, P. C., and Koller, D. (1964). Saturation deficit of the mesophyll evaporating surfaces in a desert halophyte. *Science* 146, 1320-1321.
- Whittaker, R. H., and Likens, G. E. (1975). The biosphere and man. In "Primary Productivity of the Biosphere" (H. Liéth and R. H. Whittaker, eds.), pp. 305-328. Springer-Verlag, New York.
- Wiebe, H. H., and Kramer, P. J. (1954). Translocation of radioactive isotopes from various regions of roots of barley seedlings. *Plant Physiol.* 29, 342–348.
- Wiegand, K. M. (1906). Pressure and flow of sap in the maple. Am. Nat. 40, 409-453.
- Wiersma, J. V., and Bailey, T. B. (1975). Estimation of leaflet, trifoliate, and total leaf areas of soybeans. Agron. J. 67, 26-30.
- Wiggans, C. C. (1936). The effect of orchard plants on subsoil moisture. *Proc. Am. Soc. Hort. Sci.* 33, 103-107.
- Wiggans, C. C. (1938). Some results from orchard irrigation in eastern Nebraska. *Proc. Am. Soc. Hort. Sci.* 36, 74-76.
- Wilcox, H. (1962). Growth studies of the root of incense cedar *Libocedrus decurrens*. II. Morphological features of the root system and growth behavior. *Am. J. Bot.* 49, 237–245.
- Wild, A., ed. (1988). "Russell's Soil Conditions and Plant Growth," 11th Ed. Longman Group, Harlow, Essex, England. John Wiley & Sons, New York.
- Will, G. M. (1966). Root growth and dry-matter production in a high-producing stand of *Pinus radiata*. New Zealand For. Serv. Res. Note 44.
- Willey, C. R. (1970). Effects of short periods of anaerobic and near-anaerobic conditions on water uptake by tobacco roots. *Agron. J.* 62, 224–229.
- Williams, H. F. (1933). Absorption of water by the leaves of common mesophytes. J. Elisha Mitchell Sci. Soc. 48, 83-100.
- Williams, R. J., and Leopold, A. C. (1989). The glassy state in corn embryos. Plant Physiol. 89, 977-981.
- Williams, S. (1809). "The Natural and Civil History of Vermont." 2nd Ed., Vol. 1, pp. 87-97. Samuel Mills, Burlington, VT.
- Williams, W. T. (1950). Studies in stomatal behavior. IV. The water relations of the epidermis. J. Exp. Bot. 1, 114-131.
- Williamson, V. M., and Colwell, G. (1991). Acid phosphatase-1 from nematode resistant tomato. Plant Physiol. 97, 139-146.
- Wilson, B. F. (1967). Root growth around barriers. Bot. Gaz. 128, 79-82.
- Wilson, C. C. (1947). The porometer method for the continuous estimation of dimensions of stomates. Plant Physiol. 22, 582-589.
- Wilson, C. C. (1948). The effect of some environmental factors on the movements of guard cells. Plant Physiol. 23, 5-37.

- Wilson, C. C., Boggess, W. R., and Kramer, P. J. (1953). Diurnal fluctuations in the moisture content of some herbaceous plants. *Plant Physiol.* 36, 762-765.
- Wilson, J. B. (1988). A review of evidence on the control of shoot:root ratio, in relation to models. *Ann. Bot.* 61, 433-449.
- Wilson, J. R., and Ludlow, M. M. (1984). Time trends of solute accumulation and the influence of potassium fertilizer on osmotic adjustment of water-stressed leaves of three tropical grasses. Aust. J. Plant Physiol. 10, 523-537.
- Wilson, R. H., and Evans, H. J. (1968). The effect of potassium and other univalent cations on the conformation of enzymes. In "The Role of Potassium in Agriculture" (V. J. Kilmer, S. E. Younts, and N. C. Brady, eds.), pp. 189-202. American Society of Agronomy, Madison, WI.
- Wilson, T. P., Canny, M. J., and McCully, M. E. (1991). Leaf teeth, transpiration and the retrieval of apoplastic solutes in balsam poplars. *Physiol. Plant.* 83, 225–232.
- Wind, G. P. (1955). Flow of water through plant roots. Netherlands J. Agr. Sci. 3, 259-264.
- Winneberger, J. H. (1958). Transpiration as a requirement for growth of land plants. *Physiol. Plant.* 11, 56-61.
- Wise, R. R., Ortiz-Lopez, A., and Ort, D. R. (1992). Spatial distribution of photosynthesis during drought in field-grown and acclimated and nonacclimated growth chamber-grown cotton. *Plant Physiol.* 100, 26–32.
- Wittwer, S. H. (1975). Food production: Technology and the resource base. Science 188, 579–584.
- Wolf, F. A. (1962). "Aromatic or Oriental Tobaccos." Duke University Press, Durham, NC.
- Wong, S. C., Cowan, I. R., and Farquhar, G. D. (1979). Stomatal conductance correlates with photosynthetic capacity. *Nature* (London) 282, 424–426.
- Wood, C. (1988). Urban waste water irrigates Florida citrus. Citrus Ind. 69, 14-16.
- Woods, F. W. (1957). Factors limiting root penetration in deep sands of the southeastern Coastal Plain. *Ecology* 38, 357–359.
- Woods, F. W., and Brock, K. (1970). Interspecific transfer of inorganic materials by root systems of woody plants. *Ecology* 45, 886-889.
- Woods, T. E. (1980). Biological and Chemical Control of Phosphorus Cycling in a Northern Hardwood Forest." Ph.D. Dissert. Yale University, New Haven, CT.
- Wooley, J. T. (1967). Relative permeabilities of plastic films to water and carbon dioxide. *Plant Physiol.* 42, 641-643.
- Wray, F. J. (1971). "Changes in the Ionic Environment around Plant Roots." D. Phil. Thesis, Oxford.
- Wright, J. P., and Fisher, D. B. (1983). Estimation of the volumetric elastic modulus and membrane hydraulic conductivity of willow sieve tubes. *Plant Physiol.* 73, 1042–1047.
- Wright, L. N., and Jordan, G. L. (1970). Artificial selection for seedling drought tolerance in boer lovegrass (*Eragrostis curvula* Nees). Crop Sci. 10, 99-102.
- Wright, S. T. C. (1969). An increase in the "inhibitor-β" content of detached wheat leaves following a period of wilting." *Planta* 86, 10–20.
- Wright, S. T. C., and Hiron, R. W. P. (1969). (+)-Abscisic acid, the growth inhibitor induced in detached wheat leaves by a period of wilting. *Nature* (London) 224, 719-720.
- Wuenscher, J. E., and Kozlowski, T. T. (1971). The response of transpiration resistance to leaf temperature as a desiccation resistance mechanism in tree seedlings. *Physiol. Plant.* 24, 254– 259.
- Wylie, R. B. (1943). The role of the epidermis in foliar organization and its relations to the minor venation. Am. J. Bot. 30, 273-280.
- Wyn Jones, R. G. (1980). An assessment of quaternary ammonium and related compounds as osmotic effectors in crop plants. *In* "Genetic Engineering of Osmoregulation" (D. W. Rains, R. C. Valentine, and A. Hollaender, eds.), pp. 155–170. Plenum Press, New York.
- Xu, X., and Bland, W. L. (1993). The short life and replant problems of deciduous fruit trees. Agron. J. 85, 384-388.

- Yadava, V. L., and Doud, S. L. (1980). The short life and replant problems of deciduous fruit trees. Hort. Rev. 2, 1-116.
- Yakir, D. (1992). Water compartmentation in plant tissue: Isotopic evidence. *In* "Water and Life" (G. N. Somero, C. B. Osmond, and C. L. Boli, eds.), pp. 205-223. Springer-Verlag, Berlin.
- Yakir, D., DeNiro, M. J., and Gat, J. R. (1990). Natural deuterium and oxygen-18 enrichment in leaf water of cotton plants grown under wet and dry conditions: Evidence for water compartmentation and its dynamics. *Plant Cell Environ.* 13, 49-56.
- Yakir, D., DeNiro, M. J., and Rundel, P. W. (1989). Isotopic inhomogeneity of leaf water: Evidence and implications for the use of isotopic signals transduced by plants. *Geochem. Cosmochim. Acta* 53, 2769-2773.
- Yancey, P. H., Clark, M. E., Hand, S. C., Bowlus, R. D., and Somero, G. N. (1982). Living with water stress: Evolution of osmolyte systems. *Science* 217, 1214-1222.
- Yang, S., and Tyree, M. T. (1993). Hydraulic resistance in *Acer saccharum* shoots and its influence on leaf water potential and transpiration. *Tree Physiol.* 12, 231–242.
- Yelenosky, G. (1964). Tolerance of trees to deficiencies of soil aeration. *Proc. Inst. Shade Tree Conf.* 40, 127-147.
- Younis, H. M., Boyer, J. S., and Govindjee. (1979). Conformation and activity of chloroplast coupling factor exposed to low chemical potential of water in cells. *Biochim. Biophys. Acta* 548, 328-340.
- Younis, H. M., Weber, G., and Boyer, J. S. (1983). Activity and conformational changes in chloroplast coupling factor induced by ion binding: Formation of a magnesium-enzyme-phosphate complex. *Biochemistry* 22, 2505–2512.
- Yu, G. H. (1966). "A Study of Radial Movement of Salt and Water in Roots." Ph.D. Dissert., Duke University, Durham, NC.
- Yu, P. T., Stolzy, L. H., and Letey, J. (1969). Survival of plants under prolonged flooded conditions. Agron. I. 61, 844-846.
- Zabadal, T. J. (1974). A water potential threshold for the increase of abscisic acid in leaves. *Plant Physiol.* 53, 125-127.
- Zeevaart, J. A. D., and Creelman, R. A. (1988). Metabolism and physiology of abscisic acid. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 39, 439-473.
- Zeiger, E. (1983). The biology of stomatal guard cells. Annu. Rev. Plant Physiol. 34, 441-475.
- Zeiger, E., Armond, P., and Melis, A. (1980). Fluorescence properties of guard cell chloroplasts: Evidence for linear electron transport and light-harvesting pigments of photosystems I and II. Plant. Physiol. 67, 17-20.
- Zeiger, E., Farquhar, G. D., and Cowan, I. R. (1987). "Stomatal Function." Stanford University Press, Stanford, CA.
- Zeikus, J. G., and Ward, J. C. (1974). Methane formation in living trees: A microbial origin. *Science* 184, 1181-1183.
- Zekri, M., and Parsons, L. R. (1989). Grapefruit leaf and fruit growth in response to dry, microsprinkler, and overhead sprinkler irrigation. J. Am. Soc. Hort. Sci. 114, 25-29.
- Zelitch, I. (1961). Biochemical control of stomatal opening in leaves. *Proc. Natl. Acad. Sci. USA* 47, 1423-1433.
- Zelitch, I., and Waggoner, P. E. (1962a). Effect of chemical control of stomata on transpiration and photosynthesis. *Proc. Natl. Acad. Sci. USA* 48, 1101–1108.
- Zelitch, I., and Waggoner, P. E. (1962b). Effect of chemical control of stomata on transpiration and photosynthesis of intact plants. *Proc. Natl. Acad. Sci. USA* 48, 1297–1299.
- Zhang, J., and Davies, W. J. (1989a). Sequential response of whole plant water relations to prolonged soil drying and the involvement of xylem sap ABA in the regulation of stomatal behaviour of sunflower plants. *New Phytol.* 113, 167-174.
- Zhang, J., and Davies, W. J. (1989b). Abscisic acid produced in dehydrating roots may enable the plant to measure the water status of the soil. *Plant Cell Environ.* 12, 73–81.

- Zhang, J., and Davies, W. J. (1990). Changes in the concentration of ABA in xylem sap as a function of changing soil water status can account for changes in leaf conductance and growth. *Plant Cell Environ.* 13, 277–285.
- Zhu, G.-L., and Boyer, J. S. (1992). Enlargement in *Chara* studied with a turgor clamp: Growth rate is not determined by turgor. *Plant Physiol.* 100, 2071-2080.
- Zhu, G. L., and Steudle, E. (1991). Water transport across maize roots. *Plant Physiol.* 95, 305-315.
- Ziegler, A. M., Bambach, R. K., Parrish, J. T., Barrett, S. F., Gierlowski, E. H., Parker, W. C., Raymond, A., and Sepkoski, J. J., Jr. (1981). Paleozoic biogeography and climatology. *In* "Paleobotany, Paleoecology and Evolution" (K. J. Niklas, ed.), pp. 231–266. Praeger Press, New York.
- Zimmermann, M. H. (1964). Effect of low temperature on ascent of sap in trees. Plant Physol. 39, 568-572.
- Zimmermann, M. H. (1978). Structural requirements for optimal water conduction in tree stems. In "Tropical Trees as Living Systems" (P. B. Tomlinson and M. H. Zimmermann, eds.), pp. 517–532. Cambridge University Press, Cambridge.
- Zimmermann, M. H. (1983). "Xylem Structure and the Ascent of Sap." Springer-Verlag, Berlin.
- Zimmermann, M. H., and McDonough, J. (1978). Dysfunction in the flow of food. *In* "Plant Disease" (J. G. Horsfall and E. B. Cowling, eds.), Vol. 3, pp. 117-140. Academic Press, New York.
- Zimmermann, M. H., and Milburn, J. A., eds. (1975). "Transport in Plants. I. Phloem Transport." Encyclopedia of Plant Physiology, N.S. Vol. 1, Springer-Verlag, Berlin.
- Zimmermann, M. H., and Tomlinson, P. B. (1974). Vascular patterns in palm stems: Variation of the *Raphis* principle. J. Arnold Arbor. 55, 402-424.
- Zimmermann, U., Balling, A., Rygol, J., Link, A., and Haase, A. (1991). Comments on the article of J. B. Passioura, "An impasse in plant water relations." *Bot. Acta* 104, 412-415.
- Zimmermann, U., Haase, A., Langbein, D., and Meinzer, F. (1993). Mechanisms of long distance water transport in plants: A reexamination of some paradigms in the light of new evidence. *Phil. Trans. Roy. Soc. London Ser. B* 344, 19-31.
- Zimmermann, U., Hüsken, D., and Schulze, E.-D. (1980). Direct turgor pressure measurement in individual leaf cells of *Tradescantia virginiana*. *Planta* 149, 445-453.
- Zimmermann, U., Rygol, J., Balling, A., Klöck, G., Metzler, A., and Haase, A. (1992). Radial turgor and osmotic pressure profiles in intact and excised roots of Aster tripolium. Plant Physiol. 99, 186-196.
- Zimmermann, U., and Steudle, E. (1978). Physical aspects of water relations of plant cells. Adv. Bot. Res. 6, 45–117.
- Zur, B. (1967). Osmotic control of the matric soil-water potential. II. Soil-plant systems. Soil Sci. 103, 30-38.