COMMENTS AND LETTERS TO THE EDITOR

Infiltration from a Trickle Source: Part II.

With no intent to question the validity of the interesting report by E. Bresler et al., 1971, Infiltration from a Trickle Source: II Experimental Data and Theoretical Predictions, Soil Sci. Soc. Amer. Proc. 35(5):683–689, I wish to point out that the outward flux of water from the system, purposely neglected, is more important than the inward flux from a trickle with respect to infiltration and water content distributions under a crop.

In the dynamics of irrigation what we have here is described by the simple expression

\[ Q_i = Q_o + d \]

where \( Q_i \) is the water flow (quantity per unit time) inward from a point source into an ill-defined volume of soil, \( Q_o \) is the outward flow from the same volume of soil via vegetation and evaporation over an unknown surface area, and \( d \) is the drainage component. One hesitates to use the term flux because of the imprecise definition of the surface area for \( Q_o \). \( Q_o \) is equivalent to evapotranspiration (ET × area).

Ideally \( Q_i = Q_o \) for 100% irrigation efficiency but this is not really possible nor in fact desirable because of salinity effects. However, while \( Q_i \) is, or usually is made, constant over any time interval, \( Q_o \) fluctuates widely. It fluctuates hourly, daily, weekly, monthly as weather changes. It fluctuates from near zero at night to some roughly determinable value for the day. Loss of water, \( Q_o \), (i.e. ET × area) can also fluctuate because the cross-sectional area of soil surface (spreading area) through which water passes upward to the atmosphere can change as ET itself changes.

\( Q_o \) is less than \( Q_i \) and \( d \) is positive slightly more than half the time (night time, cool periods) if \( Q_i \) is set near but not less than the seasonal average ET for the average area of horizontal spread of water in the soil. The volume of soil continuously wetted will expand, up to a limit, during these times depending to some degree upon the magnitude of \( d \). The rest of the time \( Q_o \) is greater than \( Q_i \) (daytime, warm periods), \( d \) becomes zero and the volume of soil continuously wetted from a single trickle can shrink. One can visualize this happening over a 24-hour day or over a succession of days. We have seen this shrinkage occurring gradually in an orchard over several weeks of sustained hot weather. Expansion of the wetted soil volume began again upon cessation of the hot weather.

Changes in wetted soil volume will still occur, perhaps less noticeably, if \( Q_i \) is chosen to be greater than ET for any time period of highest crop requirements. In this case \( Q_i \) is excessive for any prolonged period such as a season, and is in fact not realistic. If \( Q_i \) is always greater than \( Q_o \), \( d \) is always positive but still variable to a degree similar to, but not necessarily on the same time scale as, the variability of \( Q_o \).

What then is the time unit we can consider suitable for a dynamic equilibrium flow of water inward to the soil, yielding a small but net positive \( d \)? It is hard to imagine any realistic time unit because steady flow is never achieved. A single day-night cannot suffice because \( Q_o \) will be less than, equal to, and greater than \( Q_i \) in that time unless \( Q_i \) is deliberately chosen to be excessive. Excessive \( Q_i \) means excessive \( d \) and possibly some runoff. With \( Q_i \) set near the seasonal average ET the spread of water will slow down, become zero, or speed up, and flow may even momentarily change direction in part of the wetted soil volume during the course of a day. The same thing applies to a week or a month.

Such a complex system is not easily described and water distribution profiles in the presence of growing vegetation are not likely to agree with predictions from simple models.

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