In: M. L. Arpaia and R. Hofshi (eds.), Proceedings of Avocado Brainstorming. Session 4. Salinity Management. Pages 92-95. October 27-28, 1999. Riverside, CA. Hofshi Foundation. http://www.avocadosource.com.

CONTROLLED IRRIGATION AMOUNTS WITH FEEDBACK

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The close relationship between the amount of water applied and the depth of wetting is shown in Figure 1.

The values of θ_I and θ_F are independent of quantities of water applied. In the concept of "Field Capacity" there are two stages that need to be considered during the process of soil wetting.

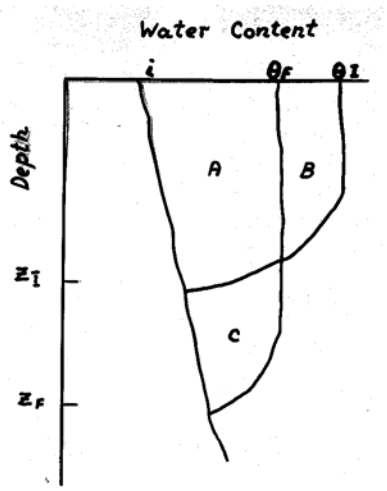

Figure 1. Soil water content distribution.

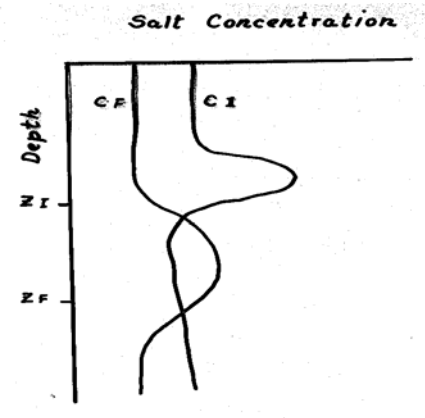

Figure 2. Salt concentration distribution.

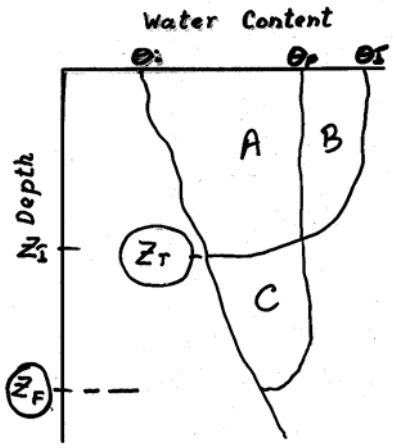

Figure 3. The final depth of wetting, Z_F.

Figure 3 shows that the final depth of wetting, Z_F, as a control parameter. We can estimate Z_F which is the depth of active root system. With this the amount of irrigation applied to the crop can be controlled based on Z_F. The basic problem: Z_F is reached at the end of the redistribution stage.

How do we solve this? First we need to define the target wetting depth to stop the irrigation, Z_{TI} which is the depth of the wetting front when irrigation should be stopped so that final wetting depth would reach the estimated value.

The advance of the wetting fronts during irrigation and redistribution is shown in Figure 4.

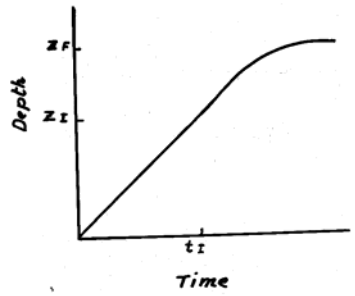

Figure 4. Advance velocity essentially constant with time during irrigation. Advance velocity dissipating during redistribution.

A system to track wetting front positions under field conditions based on quick changes in soil water content is shown in Figure 5.

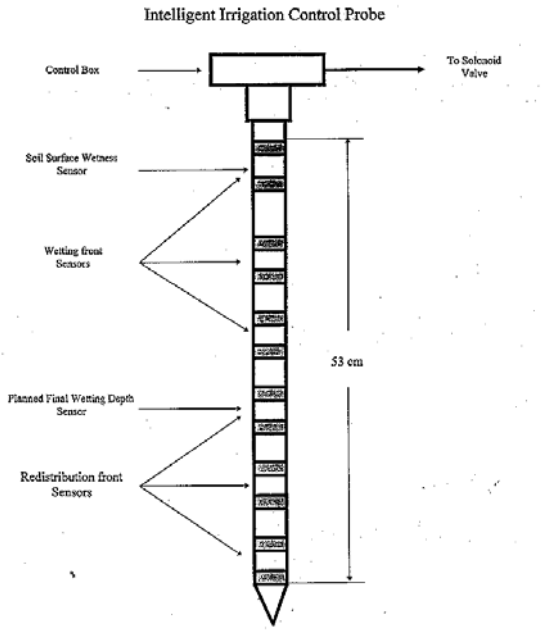

Figure 5. Presentation of wetting front position probe .

Can existing probe sense change in salt concentration? The velocity of the advance of the wetting front is sensitive to soil type, soil water content, and irrigation intensity. There are difficulties in estimating the target wetting depth to stop irrigation under realistic conditions.

Controlled irrigation amounts with feedback:

1. Input planned final depth of wetting, Z_{Ff}
2. Start irrigation
3. Track position of wetting front
4. Compute linear velocity of advance
5. Make first estimate of Target wetting depth, Z_{T1}
6. Stop irrigation at Z_{T1}
7. Compare actual Z_{F1} with planned Z_{Ff}
8. Make necessary corrections in Target Depth, Z_{T2}
9. Stop irrigation at new Z_{T2} value
10. Compare actual Z_{F2} with planned Z_{Ff}
11. Repeat 7,8,9,10 before each irrigation.

Conclusions

A system for the control of irrigation amounts based on the positions of the wetting fronts and using feedback loops with learning ability was developed and constructed.

Results from preliminary field tests (Figures 6 and 7) indicate that the proposed system is realistic and has the potential of saving substantial quantities of water, of improving the efficiency of leaching of excess salts from the root zone and of minimizing the drainage of ex-

cess irrigation water and salts to the water table. The constructed system is ready for extensive field testing.

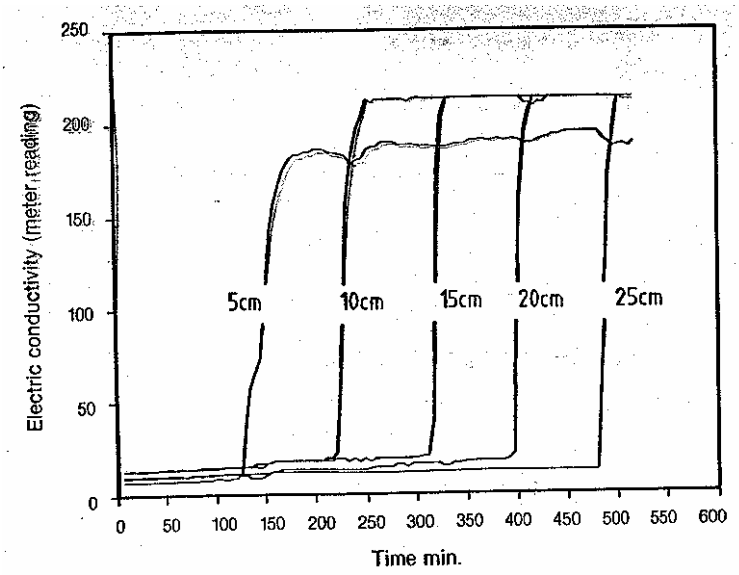

Fig 3: Response of individual sensors during

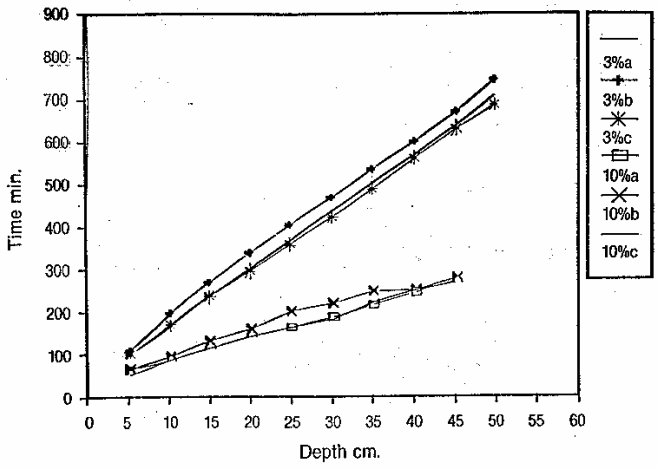

Fig 4: Time vs. Depth of wetting front under two initial moisture content during infiltration into Hamra sandy-loam soil

Figures 6 (3) and 7 (4). Measurements in soils.