Soil Moisture

(1) Preamble

While poor irrigation practices cause a host of environmental problems, irrigation can also be a sustainable practice, at times and places where it does not deplete or degrade surface water, groundwater, or soils. In times of high energy and water costs, efficient irrigation is essential to the viability of many farms and ranches. In the next few decades, more efficient irrigation may offer the best hope of feeding the world's growing population.

Given the importance of irrigation efficiency, it's unfortunate that irrigation water management is often presented as a series of complicated mathematical calculations that only an engineer could love. Irrigation management is nothing more mysterious than maintaining a suitable environment for growing crops, mainly by keeping soils from becoming too wet or too dry. There are many ways to achieve this goal, including some that require no calculations at all.
This publication describes several ways that you can check the soil moisture levels in your fields, using your hands, inexpensive probes, or new electronic devices. Of course, there's more to irrigation management than just checking soil moisture levels. You should follow general irrigation guidelines for the crops you are growing, and you should track crop water use (Evapotranspiration) as the season goes by.

No one knows as much as you do about your fields, crops, and irrigation system.
So adjust, adapt, or reject any suggestion in this publication that doesn't fit your situation or doesn't seem to be working. Use every kind of information you can find about how your soils and crops are responding, proceed cautiously, and test every recommendation with direct observations in the field.

(2) How Soils Hold Water

The water-holding capacity of a soil depends on its type, organic matter content, and past management practices, among other things. Soils are classified into one of about a dozen standard *texture classes*, based on the proportions of sand, silt, and clay particles. Sand particles are larger than clay particles, with silt particles falling in between. For example, a soil that is 20 percent clay, 60 percent silt, and 20 percent sand (by weight) would be classified as silt loam.
Other texture classes are sand, loamy sand, sandy loam, loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, siltyclay, and clay.*Coarse-textured* soils have a high percentageof sand, and *fine-textured* soils have a highpercentage of clay. Fine-textured soils generallyhold more water than coarse-texturedsoils, although some medium-textured soilshold as much or more *plant-available* waterthan some clay soils. Besides their texture classification, soils are also classified into *soil types* or *soil series*,based on soil-building factors such as geology,chemistry, age, and location. The fulldescription of a soil series includes a numberof layers or horizons, starting at the surfaceand moving downward.To identify the soil types or series in your fields, refer to a soil survey. Soil surveys aregenerally available from your local Extension office.

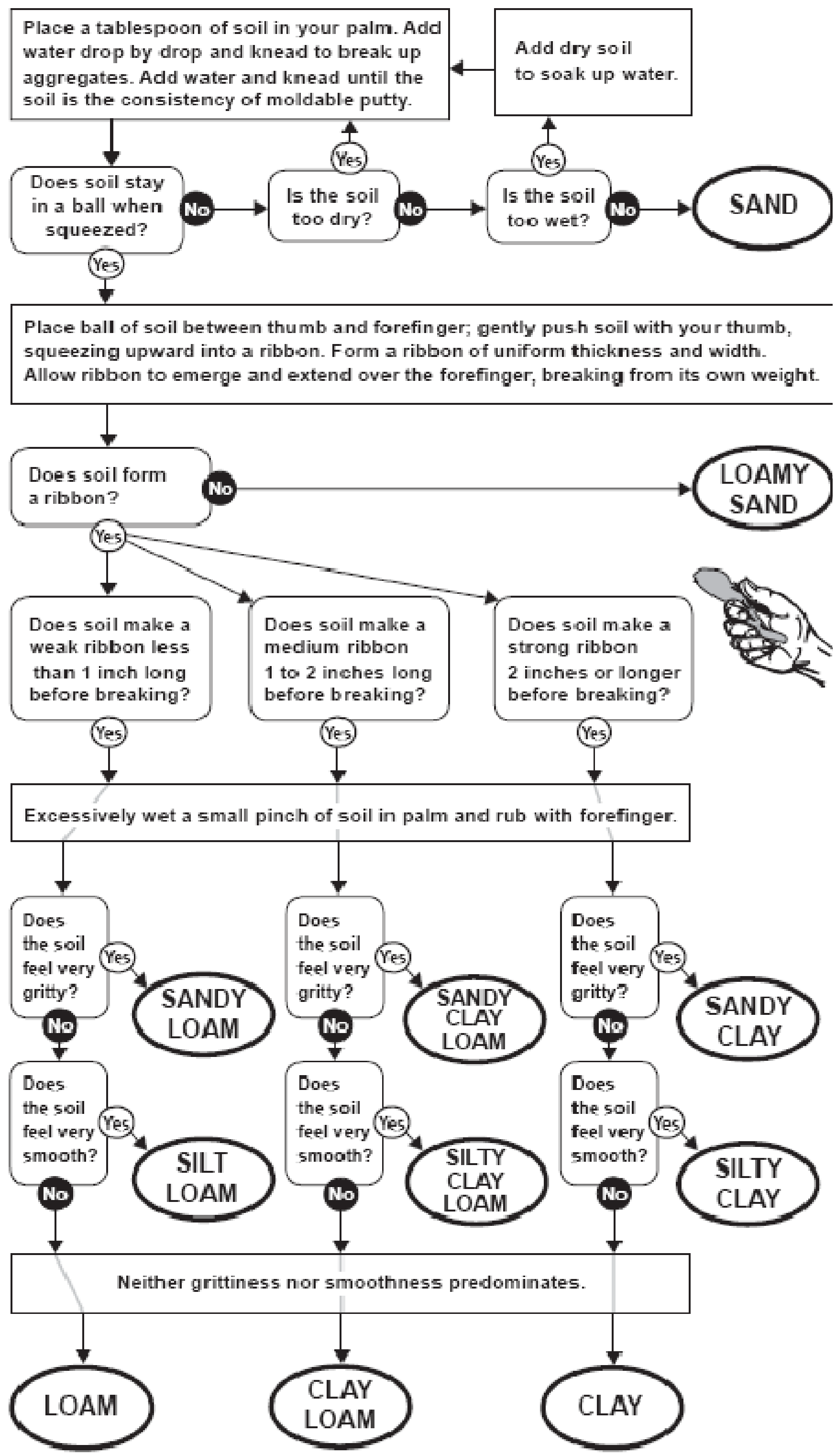

Figure1. Determining Soil Texture by the "Feel Method"

As water infiltrates soil, it fills the porespaces between the soil particles. Whenthe pores are completely saturated, some ofthe water — known as *gravitational water*— percolates down through the soil profileand below the root zone. Gravitational watermay take a few hours to drain away in sandysoils, or days or even weeks in clay soils.Evaporation at the soil surface pulls waterupward through capillary forces, while capillaryforces also hold water around thesoil particles. When a balance is reachedbetween gravitational and capillary force,water stops moving downward and is heldby surface tension in the soil – a conditionknown as *field capacity*.*Capillary water* stored in the root zone isthe most important water for crop production,but not all capillary water is availablefor plants to use. The water-holding force ofsoil, or *soil water tension*, is affected by soiltexture. For example, clay soils have smallpores and hold water more tightly than siltsoils, with their larger pores. As soil water is depleted, the films of water remainingaround the soil particles become thinner,until they are eventually held in the soilwith more tension than plants can overcome,and the plants begin to wilt.*Available water capacity* is the amount of water a soil can make available to plants, generally defined as the difference between the amount of water stored in a soil at field capacity and the amount of water stored in the soil at the permanent wilting point.

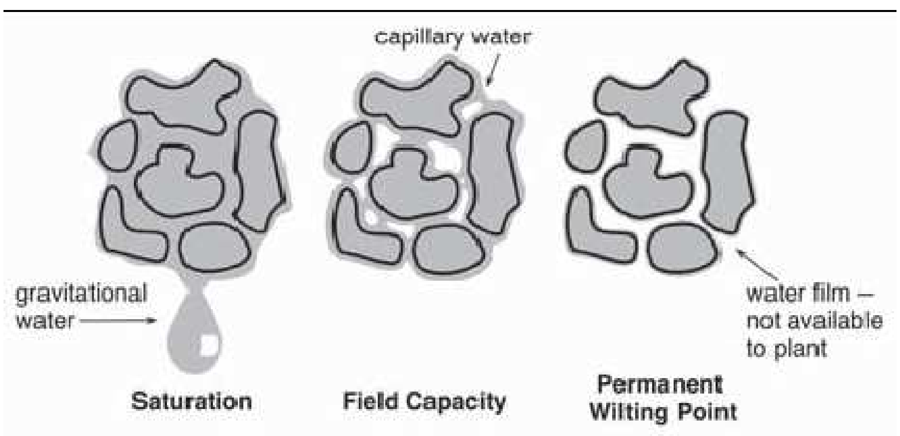

Figure 2.Saturation, Field Capacity, and Permanent Wilting Point.

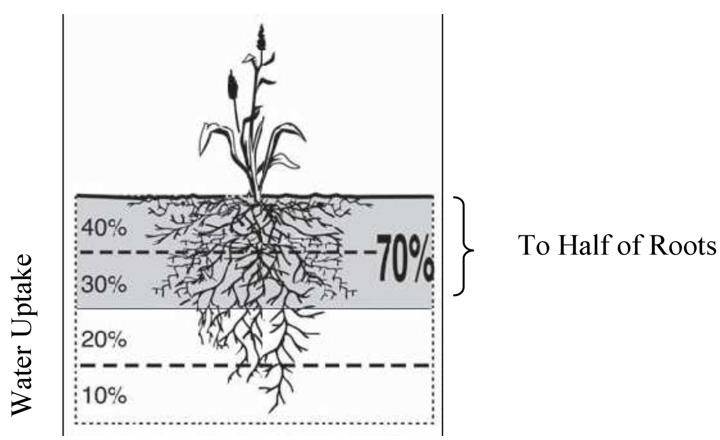

Figure 3. Effective Root Zone