Automated Measurement of Soil Moisture for Improvement of Irrigation Scheduling in Nurseries

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Intoduction

Soil moisture is the most critical factor for plant growth, especially for container grown plants. The use of calibrated automatic soil moisture sensors in combination with other automatically sensed environmental conditions such as air temperature and relative humidity will help develop improved and more efficient irrigation scheduling systems. Increased efficiency in the use of water is becoming ever more critical as water has become a precious resource, especially during the recent droughts.

Nature of Work

During the Summer of 1998 an automated weather station was installed at the Center for Applied Nursery Research (CANR) facility. This system monitors air temperature, relative humidity, wind speed and direction, solar radiation, and various other variables continuously. The data are stored in a data logger and on a daily basis the weather information is downloaded to a computer located at the Georgia Station in Griffin. After processing the data are made available via the Internet (http://www.georgiaweather.net**).**

In this project, we are adding additional sensors to monitor container moisture and temperature. With the existing weather variables measured by the station we can calculate potential demand for irrigation on a continuous basis and correlate that with the actual measures of soil moisture in containers. Eventually, with adequate correlative data, atmospheric conditions alone will serve as an accurate indicator of the state of soil moisture in all containers, allowing for a more precise and effective use of irrigation water.

Results

During the first year of the study calibration curves for a Campbell Scientific 615 probe with its leads cut short so as to fit in the typical medium sized (3 gallon) nursery container were determined and were found to be within 2% of the actual measured soil moisture. It was recommended that a separate calibration be made for each probe when using commercial nursery soil

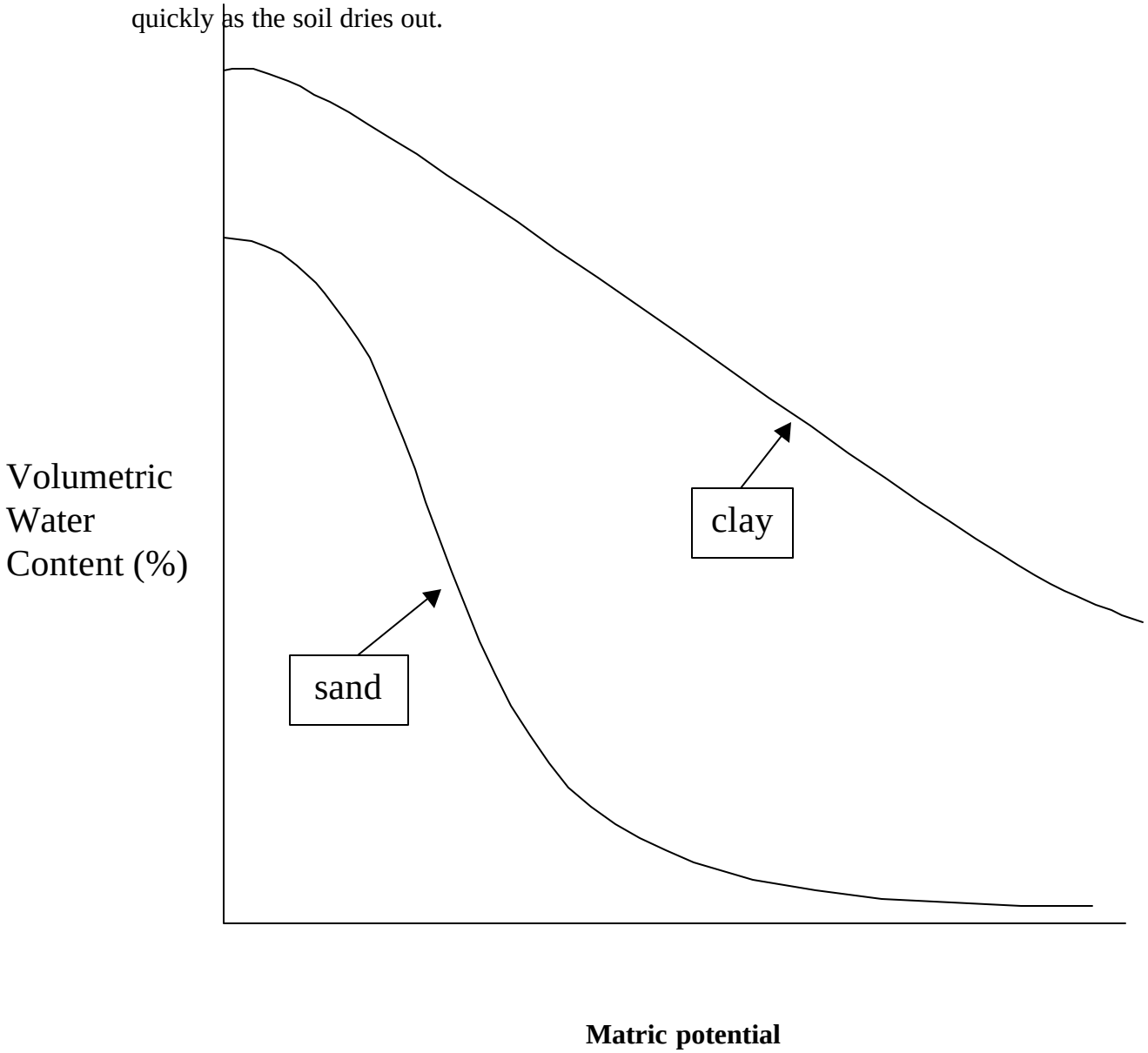
The soil mixture commonly used in the nursery has a relative low water holding capacity and a large porosity, to avoid excessive moisture build up. In the table below the analysis of the soil mixture used at the Center for Applied Nursery Research as determined in a separate study is shown:

Airspace	9.78%	18.13
Container capacity	72.9%	56.67

Total porosity	82.68%	74.8
Bulk Density	0.239	0.306

Note: Container capacity is an equivalent term to field capacity (the amount of volume of the soil taken up by water after the soil has drained). The remaining pore space is filled by air; hence airspace plus container capacity equals the total porosity.

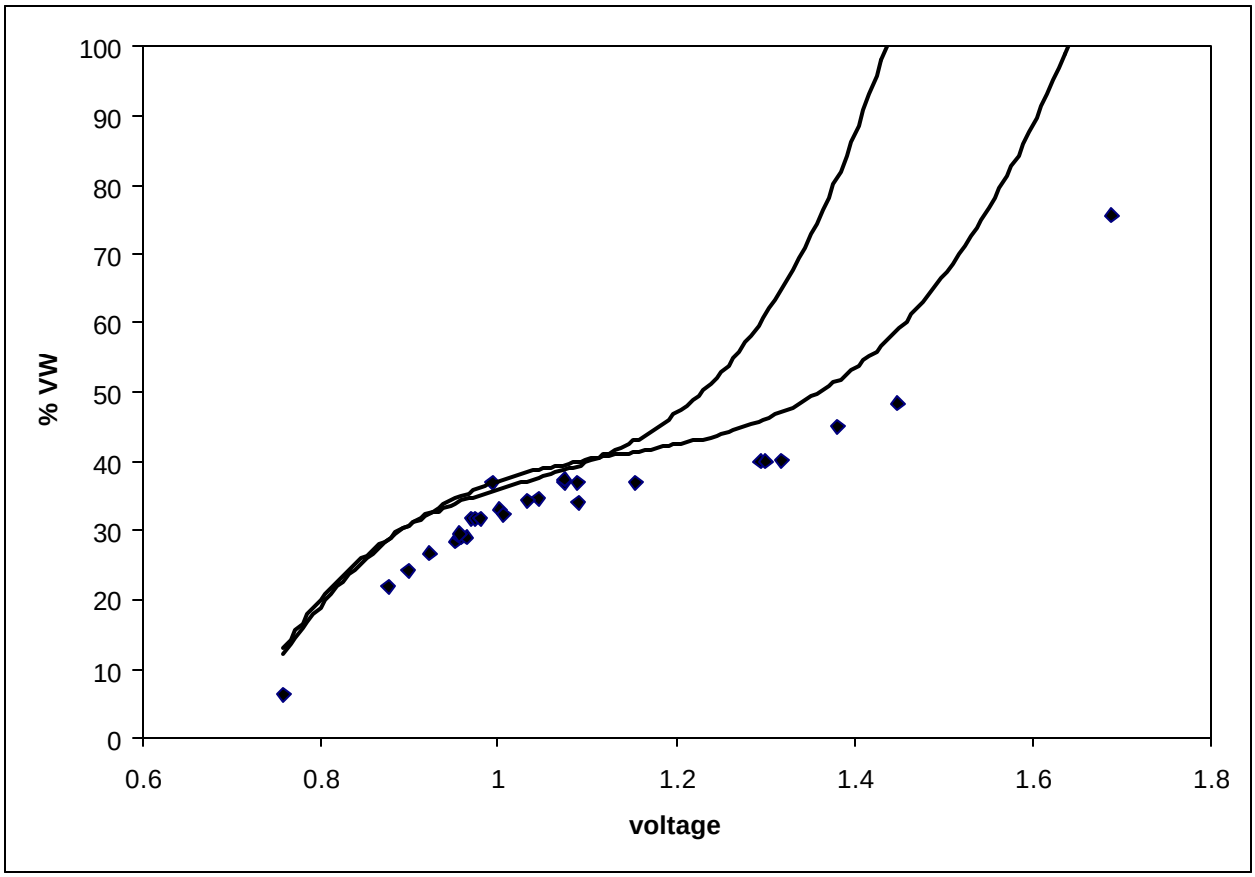
The curve below shows volumetric water as a function of metric potential for a mixture that consists of clay only versus sand. Especially for sandy soils, the water content drops quickly as the soil dries out.



During the year 2000, six (6) cut CS615 probes were calibrated with nursery soil, for eventual installation at the Center for Applied Nursery Research in Dearing. The main objective was to evaluate their functionality in containers.

The six probes showed similar relationships. Voltage as measured by the probe was directly related to soil moisture (Volumetric Water Content) as shown in the figure below.

The next step will be to install the probes in containers at the Center for Applied Nursery Research. The probes will be connected to the existing automated weather station. The probes will record voltage and with the information shown in the figure below we can convert voltage to volumetric water content.



Significance to Industry

More efficient use of irrigation water will become increasingly more important as water becomes a more valuable commodity. Therefore, the proposed system will benefit individual nurseries by optimizing irrigation applications, thereby reducing water use and improving the quality of their crop by growing a better and healthier plant. The state of Georgia as a whole will benefit from more efficient water use by nurseries that use a relatively large amount of water compared to other traditional agronomic crops.