Challenge Ahead: Water Scarcity

The years ahead will indeed be challenging if the world population increases at its current rate.

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Summary: *Crops will not grow without sufficient water and nutrients. Limited water resources could, in the future, create a paradigm shift in the fertilizer industry to generate product portfolios of water soluble/liquid fertilizers for fertigation. The bottom line is that the variables of population growth and water availability must spur innovative efforts to conserve water and nutrients to preserve adequate food production for a growing world population.*

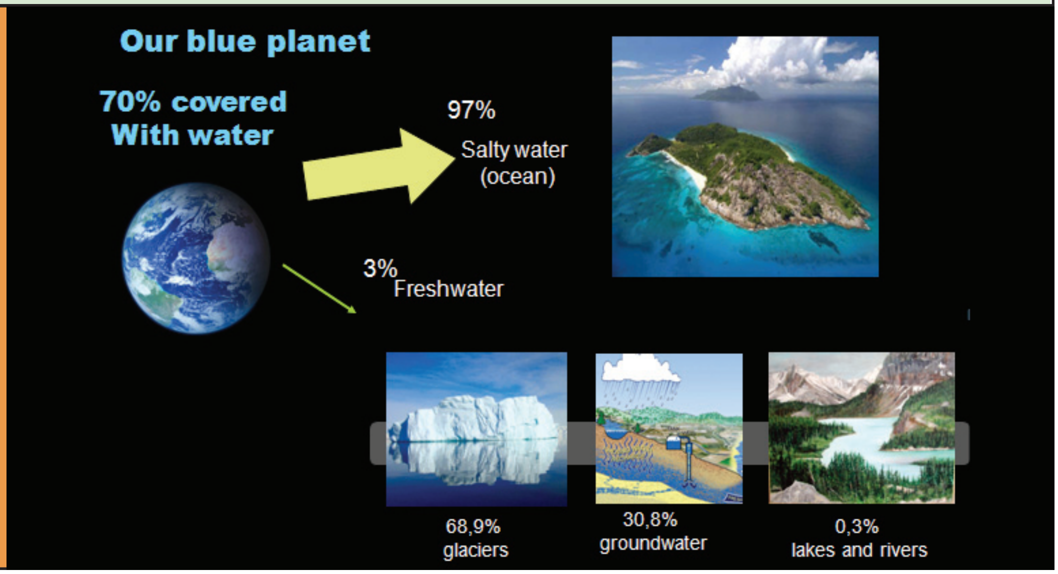

Figure 1. *Water Resources on Plant Earth*

Food production within the American agricultural system has been both challenging and rewarding during our short history. We have come a long way. Did you know that in 1790, just after the establishment of our great nation, farmers made up 90 percent of the population? As infrastructure improved and the U.S. Industrial Revolution progressed, a steady decline in the percentage of citizen farmers occurred. Today, farmers who produce food for our country and a good portion of the world make up only 1.5 percent of our population. How did American farmers evolve from sustainable agriculture to being one of the world's most important food producers? The answer, of course, is through technology and hard work. Today we are facing new challenges that will require our newest and best technology to meet these objectives. This is truly amazing since at no other time in earlier human history would this have been possible. In the vernacular of Winston Churchill, "Never has so much been produced for so many by so few."

"World population predicted to increase to 9 billion by 2050"

Flood (30-40% efficiency)

Furrow (55-70% efficiency)

Sprinkler (70%-85% efficiency)

Drip (90-95% efficiency)

Figure 2. *Irrigation Methods and Water Use Efficiency*

Population

Social scientists indicate the earth's population will increase to 9 billion by 2050. That is a 50 percent increase in the number of people living in just 38 years! With such a geometric increase in population, many variables influencing food production practices will change. Variables such as amount of arable land should remain constant or decline only slightly. But others, such as fresh water supply for agriculture, will steadily decrease with increasing population growth. So, one fact is obviously certain. We are becoming increasingly aware of a diminishing water supply and the growing challenge it imposes and will continue to impose in the years ahead. Simply put, we face the prospect of not being able to produce enough food to feed an increasing world population.

Vision needed

Fresh water. Seventy percent of our planet is covered with water, but only 3 percent of it is fresh water (Figure 1). Such a small reserve of fresh water can be problematic as population pressure increases. For example, during the 20th century, as the world's population tripled, water use increased six-fold. In the United States, we've already observed the effects of water scarcity. Did you know that the Rio Grande, for lack of water, failed to reach the Gulf of Mexico for the first time in 2001? If we continue on the same trend, we will experience a significant fresh water deficit by 2030. Currently, agriculture uses about 70 percent of all fresh water. Industry uses 22 percent, and municipalities use 8 percent. As the population continues to increase, agriculture's allocation is certain to decrease.

Irrigation. Presently, only 17 percent of our total cropland is irrigated, but it generates 40 percent of our food. We must continue with and fine tune our irrigation efforts to address our water needs in crop production.

WUE. We must increase our water use efficiency (WUE), given the dramatic yield gains through irrigated agriculture. Optimally, water placement is key. Applying water to soil volumes, devoid of crop rooting, increases inefficiencies. For example, flood irrigation is the most inefficient irrigation method, followed by furrow and sprinkler irrigation. Drip irrigation, placing water within the rooting zone, is the most efficient at 90 to 95 percent (Figure 2). We in the agricultural community must remain focused on WUE.

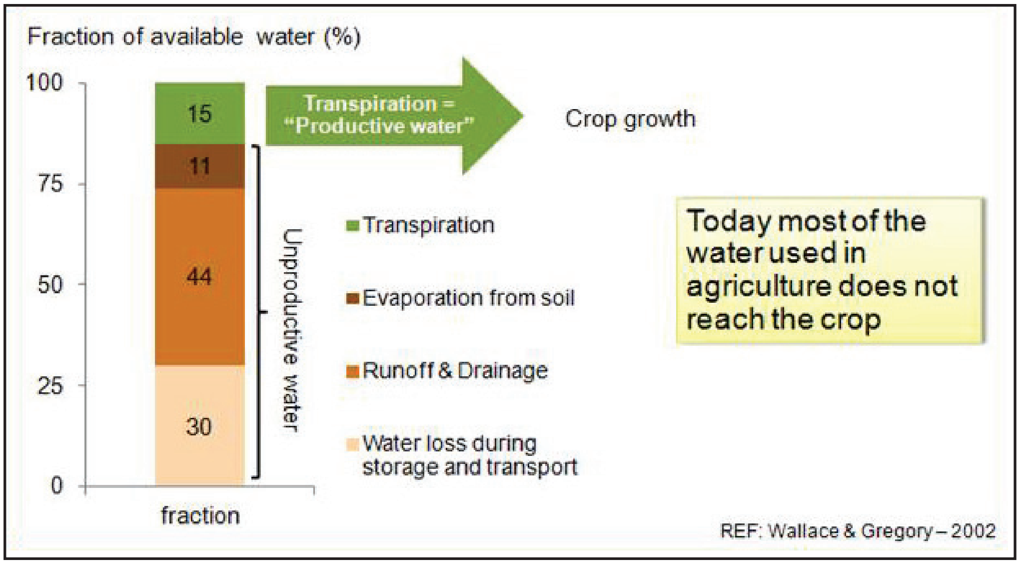

Figure 3. *Percent Water Loss during Irrigation*

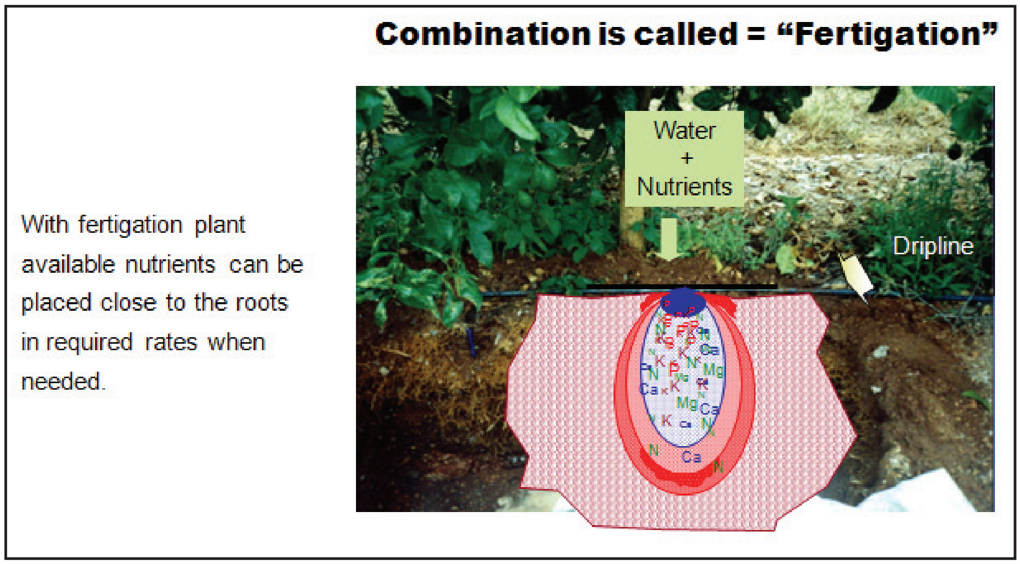

Figure 4. *Fertigation (Irrigation + Fertilization) in a Drip System is our Most Efficient Method of Water and Nutrient Use*

Water loss. Currently, research indicates that only 15 percent of irrigation water is transpired by crop plants. Almost three quarters of irrigation water is lost during transport, 30 percent in runoff and 44 percent in drainage. Limiting these losses is of extreme importance. We have the technology to prevent transport loss. We must monitor soil moisture with sensors that can terminate an irrigation event when adequate soil moisture is attained. Limited water availability will also force us to choose a highly efficient irrigation method that will limit water loss from evaporation of the soil surface. Irrigation methods on soil where crop roots are not present are very inefficient and account for 11 percent of our water loss (Figure 3).

Looking ahead

What do we see in our future?:

- Applying our irrigation water and our fertilizers together (fertigation) to the rooting zone to maximize our efficiency in crop production (Figure 4)
- Maximizing water and NUE in high density plantings. Research is currently under way at many universities in the U.S. One in Florida is categorized as Advanced Production Systems. As our need of water use efficiency increases, Advanced Production Systems can be used for commodity crop production also.

Not alone

We are not the only country addressing the challenge of water scarcity.

Israel is the leader in maximal food production with minimal water allocation and has been for years.

China has become acutely aware of water scarcity. The Yellow River is the second longest river in China and is the cradle of their civilization and agriculture. Since 602 B.C., Chinese historians have kept records of the Yellow River course changes and floods. But during 15 days in 1972, for the first time in their recorded history, the last 100 km of the river went dry. Nor was that the end of it. In 1997, the last 100 km were dry for 226 days. As a result, Chinese agricultural scientists are now seeing the value of drip fertigation compared to flood irrigation in terms of yield and water savings. For certain, inefficient water use will become a distant memory as water scarcity increases.

Summing up

Liquid fertilizers will play a crucial and leading role in generating product portfolios for fertigation to grow crops in an environment of dwindling water supplies. The bottom line is that the variables of population growth and water availability will drive our innovative efforts to conserve water and nutrients, yet maximize food production.

4 R's also must be followed:

- Right source
- Right rate
- Right timing
- Right placement.

The urgency. Time will tell, but we must be prepared to meet these agricultural challenges as our Founding Fathers did in such a masterful manner.

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