

Fertilizers to Enhance Water Productivity

Water is a scarce resource and getting the most out of every drop is critical to production of food, feed, fiber, and energy. Good crop management aims to maximize water productivity (WP). WP is the amount of product gained from each millimeter of water (i.e., kg/ha/mm or "crop per drop"). Higher WP improves crop and forage yields as well as the incomes of farmers. A key aspect of efficient water use is to ensure that adequate amounts of plant nutrient are supplied as part of agronomic best management practice (BMP) so that production is not nutrient limited. Incorporating legumes into rotations can improve WP through the influence on the quantity and plant-availability of soil nutrients.

Best nutrient management practice is achieved through 4R Nutrient Stewardship—the application of the right nutrient source, at the right rate, time, and place. The appropriate BMP for a particular crop depends on various factors such as soil type, climate, cropping system, and crop variety.

Nutrients help maximize the amount of water used productively. Water is consumed in crop fields either through productive transpiration or non-productive soil evaporation. Plant transpiration starts with the uptake of water through roots, which is transpired through leaves. During transpiration, carbon dioxide is absorbed from the air, and converted to growth and yield through photosynthesis. Evaporation of water from the soil is reduced when the surface is shaded under the crop canopy, leaving more water available for plant transpiration (**Figure 1**).

Well-fertilized and healthy crops have more vigorous and extensive roots systems that go deeper into the soil to access more stored water. The extra water allows transpiration to continue longer so more photosynthesis can occur. Adequate plant nutrition also enables crops to establish roots more quickly to access water before it percolates from the soil profile. Through the two mechanisms—increased transpiration and accessing more water—WP increases with fertilizer BMPs.

Good early nutrition improves crop competitiveness. A crop well supplied with nutrients will rapidly cover the soil surface, which not only reduces soil evaporation but also increases crop competitiveness against weeds.

From the Mediterranean region - In this region, fertilizer use on wheat is influenced by rainfall and other economic factors. Nitrogen (N) application encourages early vigorous growth, and a rapid, full canopy cover, that can result in higher yield and WP. In this area, increased WP is mainly because of higher growth and grain yield, with only small increases in water use (El Mejahed, 1993).

From Southeastern Australia - In winter cropping regions of southeastern Australia, the addition of N fertilizer on canola increased water use by less than 10%, but yield increased by over 70%. Water evaporation from the soil surface

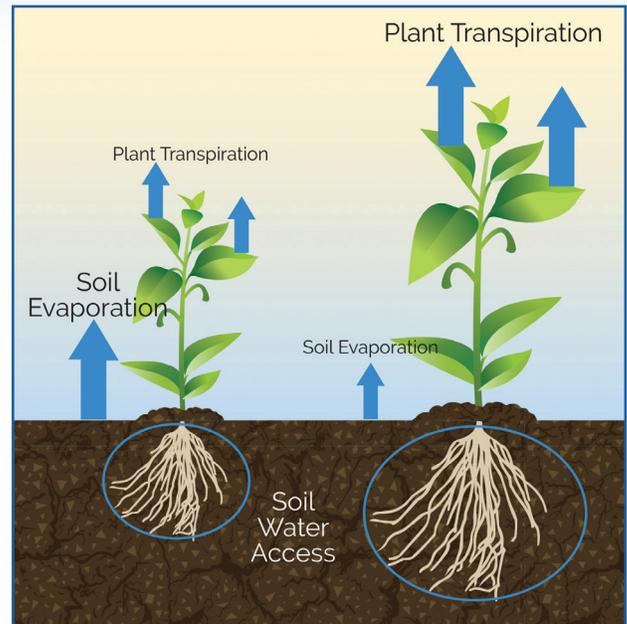


Figure 1. Poor nutrition (left) reduces root access to soil water, and relatively more water is lost as unproductive soil evaporation rather than productive transpiration.

for an unfertilized crop was between 42 and 50% of total water use, while the proportion from a fertilized crop ranged between 26 and 38% of total water use (Norton and Wachsmann, 2006).

From India - The addition of phosphorus to chickpea increased yield, water use and WP. The increase in WP was measured at 8.5 kg/ha/mm. This gain was due to a greater depletion of soil water with fertilizer, as well as an increase in yield (Hatfield, et al. 2001).

Improving water productivity is a challenge in many regions of the world with water scarcity. Good plant nutrition will mean more of the water available to crops can be used productively, thereby increasing crop yields and decreasing water losses.

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FOR FURTHER READING:

- Drechsel, P. et al., (Eds.) 2015. *Managing Water and Fertilizer for Sustainable Agricultural Intensification.* IFA, IWMI, IPNI, and IPI. 257p.