Selecting the right hybrid and planting the ideal population maximizes water usage—and ultimately yield—regardless of soil type.

But choosing the right hybrid and planting rate is no simple feat. It’s like solving a puzzle again and again for each field and each soil type/management zone within a field.

“It’s well worth the effort, though,” says Farm Journal Field Agronomist Ken Ferrie.

To begin the process of solving the puzzles, it’s important to understand the three components of yield:

- sunlight
- water
- nutrients

“These components are so tightly interwoven that you cannot separate them,” Ferrie says. “You must consider all three together.”

Think of crop production this way: Water moves from the soil through the plants, carrying nutrients with it. Ultimately, the water is transpired into the atmosphere through stomata in the leaves. This causes water to continue moving upward through the plant, carrying more nutrients. You want water to be transpired through the plants in this fashion, rather than evaporating from the soil surface.


In parallel fashion, sunlight drives production by causing photosynthesis to occur when the light strikes the leaves of plants. “Sunlight hitting the soil surface is wasted,” Ferrie notes. “It also causes evaporation.”

You want to capture as much sunlight as possible while being efficient with water. Ferrie’s light interception studies, which measure sunlight above and below the canopy, provide insight.

The rate of evaporation, or water loss out of the soil, is directly tied to leaf area index (LAI), Ferrie explains. “A leaf area index of 4 means there is 4 sq. ft. of leaf area for every square foot of soil surface, or enough leaf area to cover the soil surface four times,” he says. “As the LAI increases, water loss from evaporation goes down, and the amount of water transpired goes up. More transpiration means more dry matter production, or yield.”

When you capture 97% or more of the available sunlight, the rows are completely shaded. It also means almost all of the water leaving the soil is being transpired rather than evaporated, which is your goal.

Don’t worry too much about your crop’s LAI number. Just do as Ferrie

Light meters measure sunlight interception to help determine which leaf architecture and ear type best maximize water use on a particular soil.
does and examine how much sunlight is splotching the soil surface at the conclusion of vegetative growth.

“If I see blotches of sunlight, there’s a plant distribution problem. The stand is missing plants,” Ferrie says. “If sunlight hits the center of the row all across the field, you have done a poor job of harvesting sunlight. Sunlight that hits the ground causes evaporation, and it fails to produce more starch through photosynthesis. That means yield is being left on the table.”

You’re more likely to find problems in corn than in soybeans because of the nature of the plants. “If sunlight strikes the bottom of a soybean plant, the plant adds more branches,” Ferrie says. “Even rows as wide as 30” usually close.

“Once the rows have closed, you are capturing all the available sunlight and maximizing transpiration. If you can close your soybean rows with 120,000 plants, you will not increase yield by going to 200,000. You will simply get the same yield, or less, with fewer pods per plant.”

**Corn is a little different because plants don’t branch out.** “If a corn plant intercepts too much sunlight, it might trigger multiple ears or suckers, but it won’t cause branching,” Ferrie says. “So if you see more than a slight freckling of sunlight hitting the ground after vegetative growth has ceased and plants have tasseled, you are wasting sunlight and water. The solution is to increase your planting rate and add more plants.”

Because of the rules of sunlight interception and water transpiration, there will be no benefit from higher populations if you’re already capturing 97% of the available sunlight. For example, if you’re capturing 97% of the light with 34,000 plants, there will be no more light interception or a yield boost if you jump to 38,000 plants, Ferrie says.

“The amount of water transpired by both populations is the same, he adds. “However, you now have the same amount of water feeding 38,000 plants instead of 34,000 plants, so you have less water per plant. Less water per plant means less nutrient uptake per plant, which adds stress to the entire field. Under stressful conditions, yield might decline.”

Adding irrigation won’t change this situation. “When you have an adequate water supply in the soil, adding more water won’t help,” Ferrie says. “Water still must be pulled out of the soil through the plants, and a plant’s ability to pick up water does not change. How fast water is pulled through the plant is a function of the climate in your area—temperature, humidity and wind speed.”

Your challenge, Ferrie summarizes, is to reach 97% ground cover, or light interception, without going too far over. Or, you can think of it as capturing the most sunlight with the lowest number of plants. That’s the point at which you have no more water and no more nutrients per plant.

“There’s a correlation between plant population and water supply,” Ferrie says. “Higher plant densities demand more water in the vegetative stages (because there are more plants and more LAI). But if we reach 97% ground cover, the water loss out of the field flat lines regardless of population.

“So when deciding what population to plant on each soil type, it’s important to consider the water-supplying power of that soil—is it sandy soil that runs out of water quickly, or is it heavier soil that holds a lot of water? Soil type, texture, water infiltration capacity and soil health determine the soil’s ability to hold water.”

This is where leaf structure comes into play. Based on Ferrie’s studies, he divides most hybrids into four categories: upright; semi-upright; semi-pendulum; and pendulum or horizontal leaves (see page 18).

Leaf structure is a tool to manage light capture and water use. “If we’re planting on a sandy soil with little water, we reduce the plant population,” Ferrie says. “We still want to capture the maximum amount of sunlight in order to get the highest yield from that lower population, so we choose a hybrid with horizontal leaves, which will catch more sunlight in the middle of the row.

“If we are planting on a
heavy soil, which holds more water, or if we have irrigation, we select an upright-leaf hybrid, so more sunlight can penetrate the canopy and more of the plants’ lower leaves can participate in photosynthesis,” Ferrie says.

The final piece of the puzzle is ear type. “Based on population, all hybrids flex ear size up and down,” Ferrie explains. This includes number of kernels, girth, depth, weight and the amount of kernel abortion as the plant decides how many kernels to keep. Based on Ferrie’s studies, hybrids fall into four categories: flex, semi-flex, semi-determinate and determinate (see page 18).

It’s important to understand ear type when choosing a hybrid to plant at a lower population, such as on sandy soil (or if you’re deciding whether to tear up a poor stand). “Our years of population plots show that typical hybrids produce between 6 bu. and 7 bu. per thousand ears; with those hybrids, 22,000 ears per acre might produce only 140 bu. of corn. But some flex-ear hybrids will produce more than 10 bu. per thousand ears. With a population of 22,000 plants, that’s 220 bu. per acre.”

Ferrie’s 12 years of ear-type studies show full-flex hybrids might not be suited for very high populations because they tend to flex both ways. “Ear size flexes upward when populations are low,” he says. “Under stress, these hybrids flex backward to the point of ear abortion. At the highest populations in our plots, it was not unusual for flex-ear hybrids to drop by 20 bu. to 40 bu. per acre, while the yield of a determinate hybrid flat lined or decreased slightly.”

Remember, when you increase population, you will need more nitrogen. “That doesn’t necessarily mean you have to apply more nitrogen because heavy soils might supply a sufficient amount,” Ferrie says. “But if you push the population and don’t have enough nutrients, yields will flat line or go backward. You might have to match variable-rate planting with variable-rate nitrogen.”

A final point: Yield remains the primary factor when selecting hybrids. “Choose hybrids based on yield; insect and disease issues; and herbicide program,” Ferrie says. “Then, look for the structure and ear types that will maximize water use on your soils.”

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Narrow Rows Might Improve Water Use

“You can use narrow rows and twin rows to manage light interception and water usage,” says Farm Journal Field Agronomist Ken Ferrie. “But you must match narrow rows with an appropriate hybrid.”

If you are already capturing at least 97% of the available sunlight with your present hybrid and population in 30” rows, planting the same hybrid in 20” or twin rows and pushing up the population will merely add stress, Ferrie says. Yield might even decline.

Don’t base your hybrid choice solely on test plot results, unless each hybrid is planted at its recommended population. “If a plot winner was planted at 38,000 plants per acre, and you plant it at 32,000, you may not get the same results,” Ferrie says.

How important is it to match hybrid and your row width? “By my choice of hybrids, I can make narrow rows either win or lose in a wide/narrow row comparison plot,” Ferrie says.