

Choosing the right WATER APPLICATION PACKAGE

By Steve McCoon, CID

Understanding the factors that affect pivot water application performance is important when considering today's technology options.

For many soil types, water conditions and terrain, center pivot irrigation can be the most uniform and efficient method of irrigation. These irrigation projects are customized, planned and engineered to ensure that the equipment investment and input dollars are spent as effectively as possible.

Modern center pivot manufacturers have an amazing array of engineering and digital technology options to offer the agricultural irrigation industry. It can be a challenge to determine what specific products and technologies are appropriate for your operation.

When it comes to pivots, the water application package (sprinklers, pressure regulators, nozzles and charts) is where the rubber meets the road; or in

this case, the water meets the soil. There are many factors that affect the optimization of center pivot water application packages. Knowing these factors and how they play a role in effective and efficient irrigation is important when making decisions concerning which water application package to use and how to best use it.

Understanding irrigation's effect on soil


Every farm has its own mix of soil types, slopes, water infiltration rates and crop needs. It is key to remember that the most important part of the water delivery system from the water supply to the root systems is the soil itself. As irrigators, we can either help or hurt the soil's structure and intake rate. It is valuable to know how the sprinkler droplet size, distribution throughout the radius and




At maturity, some crops are very tall, like some corn varieties. Keeping the sprinklers on top of the pipe can help maintain a maximum radius and high uniformity.

even surface residue affect the soil intake rate. In their research paper titled, "Characterizing Droplet Kinetic Energy Applied by Moving Spray-Plate Center Pivot Irrigation Sprinklers," Bradley King, PhD, PE, and David Bjorneberg, PhD, PE, had this to say about water droplets, "The kinetic energy of discrete water drops impacting a bare soil surface is generally observed to lead to a drastic reduction in water infiltration rate due to soil surface seal formation."




 **You can read the entire paper at <https://eprints.nwisrl.ars.usda.gov/1566/>.**

The droplet sizes within the sprinkler pattern matters also. As an example, if all of your droplets were consistently a single size, it would create serious limitations to a sprinkler pattern. An intentionally designed variety of droplet sizes and stream radii are important to protect the intake rate of the soil and to help prevent surface sealing.

 **Find an interesting presentation including six truths of droplet size at: www.irrigation.org/IA/fileuploads/IA/resources/technicalpapers/2019/sprinkler-drop-characteristics_king.pdf.**

Therefore, the sprinkler type chosen, as well as the stream characteristics, velocity and specific energy of the various droplets produced by the sprinkler, will have a direct impact on soil surface sealing and

runoff potential. Silty soils are especially susceptible to surface sealing, so beware if the word "silt" is prominent in the name of your soil type.

 **If you are uncertain about your soil type or types, an easy way to find out what you have is with the free app from the U.S. Department of Agriculture-Natural Resources Conservation Service called SoilWeb. SoilWeb can be downloaded onto your mobile device from the Apple app store or Google Play. Another option is to use the Web Soil Survey website: <https://websoilsurvey.sc.egov.usda.gov/app/homepage.htm>.**

Knowing about some of the most impactful influences on your center pivot's water application package and how they relate to each other is important when making decisions regarding the type of technology and equipment appropriate for your center pivots.

Deep in the canopy of a corn crop, a low-pressure sprinkler on drops can be very effective if not spaced too far apart and if the soil intake rates are adequate.



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Shorter crops like wheat or alfalfa can benefit from drops and a lower sprinkler mounting height. At low sprinkler mounting heights it is especially important to account for field terrain to prevent the sprinklers from getting too low into the crop or even dragging on the ground.

Breaking down decision-making

The acronym CROPS is a helpful way for dealers and growers to work through the water application thought process. Each decision made relating to the way the center pivot operates will affect the performance or uniformity of the water application package itself.

C – canopy. Will the sprinklers be mounted above the canopy of the crop or within it? You may be growing corn in the Midwest or alfalfa in Eastern Oregon, but either way, having a plan based on whether the sprinklers are in canopy or not is going to have an effect on everything else. If the sprinklers are on top of the pipe or just above the canopy, locating them at a height to reduce any stream obstruction that would limit the sprinkler’s radius must be considered, and

obstructions must be avoided if possible. Any water that may have been lost to evaporation will not matter much if you have overwhelmed the soil by having too little radius and/or too large a droplet and are then seeing water and soil run out of the field. The “sweet spot” for sprinkler height has to do with where it can be mounted to minimize stream or droplet obstruction.

R – radius. Your decision on where to place the sprinklers in relation to the crop canopy will impact the effective radius of the sprinklers. For maximum radius, place the sprinklers at about the height of the crop at maturity but avoid as much structural steel as possible. If wind is an issue or the sprinklers are down deep in the canopy, you will not be able to use wide spacing. For in-canopy sprinkler placements, a reduced effective radius will result.




IT IS KEY TO REMEMBER THAT THE MOST IMPORTANT PART OF THE WATER DELIVERY SYSTEM FROM THE WATER SUPPLY TO THE ROOT SYSTEMS IS THE SOIL ITSELF.

O – **outlet spacing.** Given the effective radius of the sprinkler, what does the outlet spacing need to be for adequate coverage of water to the soil? You will want to place sprinklers so that they can cover each other as much as possible given the available span pipe coupler spacing. As a rule-of-thumb for over-canopy sprinklers, 150% coverage should be considered a minimum.

P – **pressure.** At this outlet spacing and canopy placement of the sprinklers, which pressure is optimal? If the sprinklers are above the canopy, they can benefit from pressure to achieve maximum radius. Higher pressures can also lead to wider radius, higher uniformity and gentle droplets. If sprinklers are down in the crop canopy and closer together, a lower pressure 10 psi regulator is commonly a great choice.

S – **soil intake rate.** You will need to know your soil intake rate and water-holding capacity within the crop's root depth. If, when all of the above-mentioned decisions have been made and the soil intake rate and surface storage in the field are exceeded, there will be potential for runoff. We must be able to meet our crop evapotranspiration demands and avoid runoff of water and nutrients from the field or within the field. If excessive water runoff is an issue, go back through the CROPS acronym again to find ways to reduce the average application rate while still meeting the maximum crop ET. You may need to place the sprinklers higher or even switch to a different type of sprinkler or drop for increased radius. Another consideration could be to increase the amount of crop residue in the field, increasing soil surface penetration and storage. Runoff must be eliminated and maximum uniformity achieved. Part-circle sprinkler technology also helps prevent wheel track issues, which can be affected by the soil intake rate.

Whether you are buying a new center pivot or updating an existing water application package, use these ideas to get the most out of your investment. Using the suggestions provided in the CROPS acronym can help you optimize your sprinkler package given the canopy height, soil, topography and climate while meeting your crop potential. 

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