

Surge: The Cutting Edge of Irrigation Technology

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Surge has emerged as a formidable player in the irrigation field in the '90s. Its improvements to surface irrigation put it firmly at the cutting edge of irrigation water-use efficiency. In the past few years, field researchers have investigated some significant new roles for surge that rely on its ability to layer water uniformly, and control runoff and drainage. Some very promising new applications include using surge to irrigate furrow rice, control nonpoint source pollution and to automate fertigation through surface systems.

Before surge came to the field, surface irrigation water-management strategies were few. The high return benefits were, at best, labor-intensive or simply unattainable through the furrow. Since the mid-1980s, surge has proved consistent in using less water and moving it faster. But the key to finding more advantages and applications for surge has been its ability to apply water uniformly: to create a shallow, even water profile and keep it at the root zone. This level of control, coupled with automation, has broad implications for surface irrigation and gives surge a strong footing with pivot and drip technologies.

Surge boosts some surface irrigation application efficiencies by as much as 40 percent. It matches drip efficiencies of 85 percent in studies by Washington State University that compare surge to drip for light, frequent irrigations. A solar powered surge system costs a fraction of the higher-tech, hard-wired pressure systems. The costs of a surge system, including the price of PVC pipe, can average as little as \$80 to \$100 per acre or considerably less if it is retrofitted to existing pipe. On average, a system pays for itself in one to three years. It also waters corners.

Surge is now recognized as a best management practice (BMP). Its use has spread to every state in the West. Many local soil- and water-conservation districts have approved from 50- to 75-percent cost-sharing for surge. It is finding a home in a surprisingly diverse range of soil types and surface-irrigation water-management practices.

One example of an exciting new application of surge-to-surface irrigation is on irrigated rice field tests in the Mississippi Delta. Last season, surge was employed on the Mascot Plantation near Clarksdale, MS, to help break the tradition of flooding rice under levees and test the efficacy of new herbicides on furrow irrigated rice. These "flat" rice trials sought to increase irrigation efficiencies and control management, labor and fertilizer costs compared with conventional levee rice. Surfing can reduce furrow water distribution problems and fertilizer demand, which decreases overall application costs.

"I have a definite need for the surge valves on my furrow rice as a management tool," says Mike Carr of Mascot Plantation. "Surge allowed me to water a 110-acre field with just one pump and two lines of polypipe along the two sides, with the surge valve in between. On a humpback ridge with fall on two planes, I put the pipe on either side and watered both at once with surge. This freed up my labor to water more fields. I will definitely use surge again this season. I'd like to know more about surge fertigating furrow rice. Once I know more, I may try it."

One of the most extensive and productive research projects to date with surge is controlling nonpoint pollution in the Colorado River. The Colorado State University Cooperative Extension Service, with funds from the Bureau of Reclamation, had impressive results in the Grand Valley and Lower Gunnison River Basin. A study begun in 1990 focuses on better irrigation water-management practices in the Grand Valley to reduce the salt load in return flows above and below grade to the Colorado River. In the first year, deep percolation was reduced by nearly an acre-foot per demonstration acre. Surge irrigators stopped 790 tons of salt from entering the river, and CSU researchers figure it saved downstream water users an estimated \$58 per ton of salt. By the end of 1991, the surge project had doubled its expected salt-load cutback and reported reductions at 172 percent of the target.

The CSU Cooperative Extension Service just released the results of its 1994 Surge Irrigation Research and Demonstration Project measuring the impact of surge on salt control in Delta and Montrose counties during the past two years. The cumulative salt-load reduction to the Colorado River reported was 3,430 tons. It is an impressive total because it is taken from a broad base of field and crop conditions on slightly fewer than 1,000 total demonstration acres. Many of the fields where surge was tested were under 12 acres. The crops ranged from silage to broccoli on soils from clay loam to sandy clay loam. Most of the participating farmers had irrigated for more than 30 years. Researchers estimate the amortized cost savings at \$8 per ton of salt. In Montrose alone, on 473 irrigated project acres, more than 1,000 tons of salt were kept back in the shale formation and out of the Colorado River by using surge.

The study compared surge with conventional flood for water applied, runoff and deep percolation. Surge cut the conventional numbers in half. One farmer who participated in the CSU study was Clyde Noah.

"Every irrigation season, my basement would get soaked with water," he says. "After I started using surge, the flooding stopped. I am sure that deep percolation was reduced greatly and took care of the problem. I saved water and also doubled my yield for the past two years. Irrigation water management is meaningful to me."

Max DeBusk, another CSU study participant, says, "Surge saved me from having to buy extra water. It also cut in half the time it took me to irrigate. The hay production has almost doubled and corn yield improved. Surge eliminated the problem of water dying in the middle of the field. I would not trade it for anything else."

Yet, of all the advantages of surge irrigation, fertigation may be the most beneficial. During the field-salinity trials, almost as an afterthought, one of the surge-demonstration participating farmers agreed to look at the effects of fertilizing his corn through the surge valve during the next-to-last cutback (or soak) cycle. He normally applied his fertilizer dry. It subsequently leached out in significant quantities through the surface and subsurface drainage during conventional irrigation.

The surge result was potentially spectacular. His silage corn yield increased by 12 percent to 27.6 tons per acre. Residual nitrogen in the first 2 feet of the profile increased by 14 percent at the end of the season. More irrigators jumped in. Yields continued to run above average, even compared to surge irrigation with conventional fertilizer use. Surge fertigation saved up to 25 percent in fertilizer costs. Irrigators claimed fertigation was a quick and easy way to apply chemicals, eliminate the ground rig, save labor and fuel, and reduce soil compaction.

David Seymour was another CSU demonstration participant who tried fertigation and was sold on it. "Surge irrigation is a water-management tool I use," he says. "Combined with it, I use fertigation to apply nitrogen at pollination. In combination, the two systems are management practices aimed at greatly improving water quality and top crop yields."

While fertigation is not a new concept, Dan Champion and Richard Bartholomay, two CSU irrigation specialists, agree that for surface systems, "Injecting fertilizer through a surge system is by far the best way to feed and water your crop."

In a report issued by the CSU Cooperative Extension in 1992, they listed the advantages and disadvantages of adding fertilizer through a surge valve. The advantages include rapid and efficient fertilizer application; minimized deep-percolation and gaseous losses of nitrogen; elimination of the need for power equipment in the field equals fuel savings; and the addition of fertilizer as the plants need it. Disadvantages include: calibration of the fertilizer flow rate and pitting of the metal components may occur if the last cutback cycle is not used to flush it.

New fertigation software is available that enables farmers to automatically fertilize and flush. One of the options is "chemigate," which automatically signals the injection pump to add fertilizer at the appropriate time to a selected number of soak cycles, adding one last set of cycles to "flush" the chemical.

Perhaps the most exciting implication of the new levels of efficiency surge delivers to surface irrigation is not only the benefits themselves, but that these benefits are available to a large segment of irrigators at a reasonable price. Growers on small farms, with economies of scale, irregular acres or low-cash value crops form a broad base of 50 percent of all domestic irrigation. For those growers, and for much of the irrigated land worldwide, the costs of high technology are out of reach. With surge irrigation, a dramatic leap in efficiency and potential yield is easily accessible.