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Evaluating Drip

Evaluation of drip and microsprayer irrigation systems in California's central valley.

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The Irrigation Training and Research Center (ITRC) at California Polytechnic State University (Cal Poly), San Luis Obispo, Calif., has developed widely used techniques and software for evaluating on farm irrigation system distribution uniformity (DU). Global DU is measured and accounts for non-uniformity across the whole field. For drip and microspray systems (drip/micro), non-uniformity components are:

- Flow rate differences between emitters, caused by pressure differences between emitters.
- Flow rate differences between emitters at the same pressure. This category we called "other causes," and included causes like plugging, wear and manufacturing variation.
- Unequal drainage due to start-up and shut-down times.
- Unadjusted set times in different blocks that have different plant/emitter spacings (Unequal application rates).

DU is technically called the low quarter DU (DU_{lq}).It is computed using standard formulas: DU_{lq} = average of the lowest quarter of all measurements/ the average of all the measurements. A "measurement" is the inches of water received by a plant. A DU_{lq} value of 1 indicates that all plants received the same amount of water.

Traditionally, a new drip/micro system (prior to plugging, wear, and mis-adjustments of pressures) with a DU_{lq} between 0.88 and 0.92 has been considered very good. A new system DU_{lq} of 0.95 has generally been considered to be excellent and difficult if not impossible to obtain. DU_{lq} values greater than 0.88 are beyond the reach of most other irrigation methods (furrow, border strip, hand move sprinkler), if one considers all the components of global uniformity across a whole field. The question, of course, is this: Although these DU_{lq} numbers are supposedly attainable wit a new drip/ micro system, what is actually found in the field?

In the summers of 1997 to 2001, ITRC received funding from the U.S. Bureau of Reclamation Mid-Pacific Region to train and supervise two-person evaluation teams. Irrigation districts in the San Joaquin and Sacramento Valleys (when combined, known as the "Central Valley") assisted in contacting interested farmers.

The team members attend regular Cal Poly irrigation classes, plus attend a three-day irrigation evaluation short course taught by ITRC every spring. Senior ITRC staff then go into the field with the student teams for their first two evaluations. The first three weeks students must send all of their data, results and anticipated recommendations to ITRC for review prior to submitting anything to the farmers. About three weeks of careful supervision are needed before the students become competent in conducting and interpreting evaluations. It has become very clear that a successful evaluation program requires excellent training, facilitating software, proper testing equipment and a high level of technical support early during the program.

A field evaluation typically requires a full day by the student team. This includes time required to contact the farmer, conduct the evaluation, enter the field data into the computer, draw a sketch of the field showing where measurements were taken, develop recommendations, and finally review the results with the farmer.

A total of 229 evaluations of drip/micro systems were conducted by the student teams during these summers. Additional evaluations were conducted on fields with furrow, border strip and various sprinkler systems. The final results show an anticipated spread in results, but the overall DU_{lq} values were higher than expected. (see Table 1).

Irrigation Method	# of Fields Evaluated	Avg. DU_{lq}	Coefficient of variation of the DU values
Drip	83	.85	.17
Microspray	146	.80	.13
Total or Average	229	.82	.15

Table 1. Summary of ITRC Drip/Micro evaluation results.

RESULTS

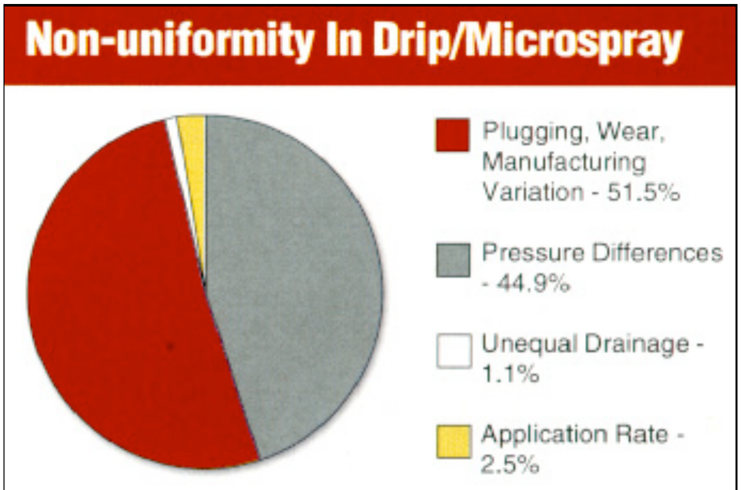
Table 1 shows that average DU of the drip systems is higher (.85) than the average for the microspray systems (0.80). This is probably due to two causes: (i) many of the newer drip systems use excellent pressure compensating emitters, and (ii) it is not unusual for microspray systems to the injection of abrasive, impure gypsum.

Nevertheless, the worst performances were seen with drip systems -- perhaps because with microsprayers it is obvious when there is plugging. Also, buried drip systems can have extensive root intrusion This will help ensure problems.

In any case, data clearly show that it is possible to achieve very high uniformities in the field with drip and microspray systems if both design and maintenance are good. The average age of the systems was six years.

Interestingly, there is no correlation between the age of the system and the DU. Another way to interpret this is that a new system can have a high or low DU.

As a result, I would suggest you review the "Irrigation Consumer Bill of Rights" prior to purchasing a system. The information is downloadable at



Maintenance and pressure differences are the main components of non-uniformity for both drip and microspray.

Although unequal drainage is a serious problem on systems with steep topography and short set durations, overall it was ranked very low (1.1 percent) in importance.

Likewise, non-uniformity due to "application rate" is very important on some fields, but overall it was only responsible for about 2.5 percent of the measured non-uniformity.

LESSONS LEARNED

The study revealed several lessons:

- Irrigation evaluation programs must use standardized evaluation techniques, and the programs require strict quality control measures.
- The average field DU_{lq} values for drip and microspray systems that have, been observed are quite high - greater than 0.8, on the average.
- The two primary recommendations for farmers to obtain and maintain systems of high uniformity are: A.) the customer should review the Irrigation Consumer Bill of Rights (ICBR) with a dealer before purchasing a system and; B.) excellent maintenance is important.
- The two primary components of non-uniformity are: A) "other causes," which include manufacturing variation, plugging and wear. The individual emitter design will influence how easily it plugs and wears, but good maintenance is critical and; B) pressure variations. There

isn't much that a farmer can do to eliminate pressure differences along a hose, but often pressure regulators at the. heads of blocks and hoses can be installed or re-adjusted properly.

In summary, it is possible to achieve the high "potential" DU_{lq} values of greater than 0.88 in the field and to sustain these high values for decades if the design and maintenance programs are good.

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