

A MOBILE IRRIGATION LAB FOR WATER CONSERVATION: II EDUCATIONAL PROGRAMS AND FIELD DATA

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Abstract

A Mobile Irrigation Lab (MIL) has been developed to promote water conservation in irrigated agricultural systems through educational programs and technical assistance. Educational programs include hands-on computer training for producers and consultants on irrigated related software. Software examples, developed as a part of MIL, include KanSched, an ET-based scheduling tool, and FuelCost, an irrigation energy cost evaluation program. Producer acceptance and use of software packages has been increased with hands-on computer training. Center pivot sprinkler package uniformity evaluations have also been conducted as a part of MIL. Field tests have been conducted using a MIL measuring device called an IrriGage. MIL software and information are available on the MIL website (<http://www.oznet.ksu.edu/mil/>). Field results indicate many systems have water distribution weaknesses.

Introduction

The Mobile Irrigation Lab (MIL) project is an educational and technical assistance program that is focused on enhancing the irrigation water management practices of Kansas irrigators. It is an outgrowth of experiences gained from long-term on-farm demonstration projects in south-central and western Kansas. The MIL field unit is a 16 foot trailer partitioned into a classroom/office area in the front and an equipment compartment in the rear (Figure 1). The front office area allows on-site training and data analysis opportunities. The bulk of the equipment carried by MIL are IrriGages. IrriGages are non-evaporating, in-field measuring devices used to catch irrigation applications by center pivot and linear irrigation systems. The catch data can be used to calculate a distribution uniformity coefficient which is a measure of the sprinkler package performance.

Educational Activities I: Computer Software Training

MIL educational activities have included the traditional classroom/lecture format with program information and study results are presented in a lecture. These presentations have been both stand alone presentations of MIL materials only, while other presentations were incorporated into other agronomic and/or irrigation management meetings and field tours. The special educational focus of MIL has been hands-on computer training for producers and agency personnel. While the bulk of the training has been conducted in a class room setting, using MIL laptops to set up as a computer lab (Figure 2), a unique feature of MIL is the ability to do one-on-one computer training at the field site (Figure 3). The front half of the MIL trailer can easily accommodate 2 or 3 individuals. The laptop computers can also be carried into the home or office of an interested producer.

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The ET based irrigation scheduling program, KanShed, described more completely in the companion paper by Clark et. al in this proceedings, has been the primary focus of the computer training sessions. Other software covered in the training sessions have included FuelCost, an irrigation energy pumping cost evaluation program and Center Pivot Depth Calibration, (also see Clark et. al., this proceedings).

Formal training sessions have been attended by producers, irrigation managers, crop consultants, NRCS and Conservation District personnel, county agents and other agency personnel. KanSched has been accepted and approved by Kansas NRCS and the Kansas SCC (State Conservation Commission) as a cost-share eligible program. In addition, producers and agency personnel have received instruction from previously trained individuals. Several hundred MIL resource CD's, containing both information and software, have been distributed upon request. Resources are also available via the MIL website at <http://www.oznet.ksu.edu/mil/>.

Educational Activities II: Center Pivot Uniformity Testing

The second aspect of MIL is an emphasis on field evaluation of cropping systems and resource management. The initial emphasis has been evaluation of center pivot sprinkler packages for distribution uniformity. The initial rationale for testing was that if irrigation scheduling procedures result in "just in time, just enough water application", then the water must be distributed so that plants have equal access to the water to prevent over- or under-water within the field, which would have yield implications.

Center pivot systems are the dominate irrigation system in Kansas, representing about 80 percent of the irrigated acres. The sprinkler package design is based on a number of factors. They have been largely assumed to be properly operating if the pivot point pressure and flow rate are set at the design operating conditions. Routine evaluation of the center pivot sprinkler package after installation is seldom, if ever, performed by the installer. Testing involves placement of multiple catch containers along the lateral of the system and then measurement of each catch. The catch containers used had to be measured quickly in order to avoid measurement error that would be introduced by evaporation losses. Therefore, a number of individuals had to be present at the test site for quick measurement. Measurement required entry into a very wet field, making for difficult data collection.

Development of a more streamlined testing procedure has been made possible through the use of IrriGages. IrriGages are a non-evaporating collection device (see Clark et. al., this proceeding for further description) as shown in Figure 4. A series of IrriGages are placed along the center pivot or linear lateral and are normally spaced at about 80 percent of the nozzle spacing. The IrriGages are placed so that all water from a complete pass of the center pivot is collected. The data collected includes the volume of catch and the position radius of the IrriGage relative to the center pivot point or the end of the linear system. System operating and package characteristics also recorded the catch data which are entered into a MIL uniformity evaluation program where the average depth of application and the coefficient of uniformity (CU) value is calculated. The program also plots the catch data which helps to visually identify the location of package weakness.

The MIL uniformity testing program has several goals including 1) development of the testing procedure, 2) development of a data base of characteristic uniformity performance criteria for various nozzle package types and configuration that could improve design and installation recommendations, and 3) improved performance for individual operator's systems.

The 2002 growing season has, in general, been very difficult throughout Kansas, resulting in watering problems that indicate poor uniformity. Examples of poor uniformity are shown in Figures 5 and 6, where corn height differences are seen.

Test Result Examples

The uniformity test results for four systems are shown in Figures 7 through 10. Figure 7 is a rotator equipped center pivot system with a CU of 84 percent. The major spike in application depth in the inner part of this system, was a leaky tower boot. The inner span of many systems have higher than average application depth.

Figure 8 shows a flat spray system with a very low CU value of 50 percent. The water supply for this system has very high iron and other mineral content and there was visible accumulation of materials on the system, nozzles and splash plates. A number of nozzles that had a deficient spray patterns were noted. Problems were related to either partial plugging of the orifice or crust accumulation on the splash plate.

Figure 9 shows the results from a flat spray equipped system in rolling sandhills near Garden City, Kansas. The non-pressure regulated flat spray nozzles were tested in high wind conditions. During the set up of the test, it was expected that the CU value would be very low due to the elevation differences along the center pivot lateral and the high wind conditions. However, the CU value of 82 percent was higher than expected. Two leaks are noted as spikes in the application depth. The center point spike was due to continuous over-spray near the center pivot point, due to the high wind conditions. The spike at the mid-point of the system may have been an unobserved leak.

The results for a new system equipped with I-Wob nozzles (Figure 10) showed an increasing depth of application with increase of radius. The application depth was approximately one-third greater in the outer portion as compared to the inner portion. This is the most problematic of the examples shown, but the cause may be related to improper flow or pressure conditions. The CU value of 82 percent was surprising good, however, the variation in average application down the lateral needs to be addressed.

Other tests have revealed installation problems, such as missing drop nozzles and reversal of tower nozzle sequences. Poor performances have also been attributed to changes in operating conditions as compared to original design specifications. Another possible cause of low uniformity could be internal incrustation similar to the material encrusted on nozzle splash types, which would alter friction loss characteristic of the system resulting in loss of design integrity.

Future Activities

Development of additional decision-support software and computer training activities will continue. Distribution of the information will continue via educational meetings, conferences and training sessions. However, resource materials are also web-based. Refinement of the uniformity evaluation procedure will continue but an immediate goal will be to develop an IrriGage test kit which would include testing procedure instruction, IrriGages, and data forms and other necessary test equipment. Test kits would be made available for use by producers or agency personnel to increase the number of systems evaluated.

Acknowledgment:

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Figure 1: MIL is a combination classroom and field laboratory.



Figure 2. MIL computers in use in a conference room for on-hands computer software training for a large group.



Figure 3. The front portion can be used for on-site one-on-one software training.



Figure 4. Series of IrriGages being positioned prior to an evaluation.



Figure 5. Corn height differences were noted in many fields in 2002 due to non-uniform water application.



Figure 6. Corn growth was suppressed under a plugged nozzle.

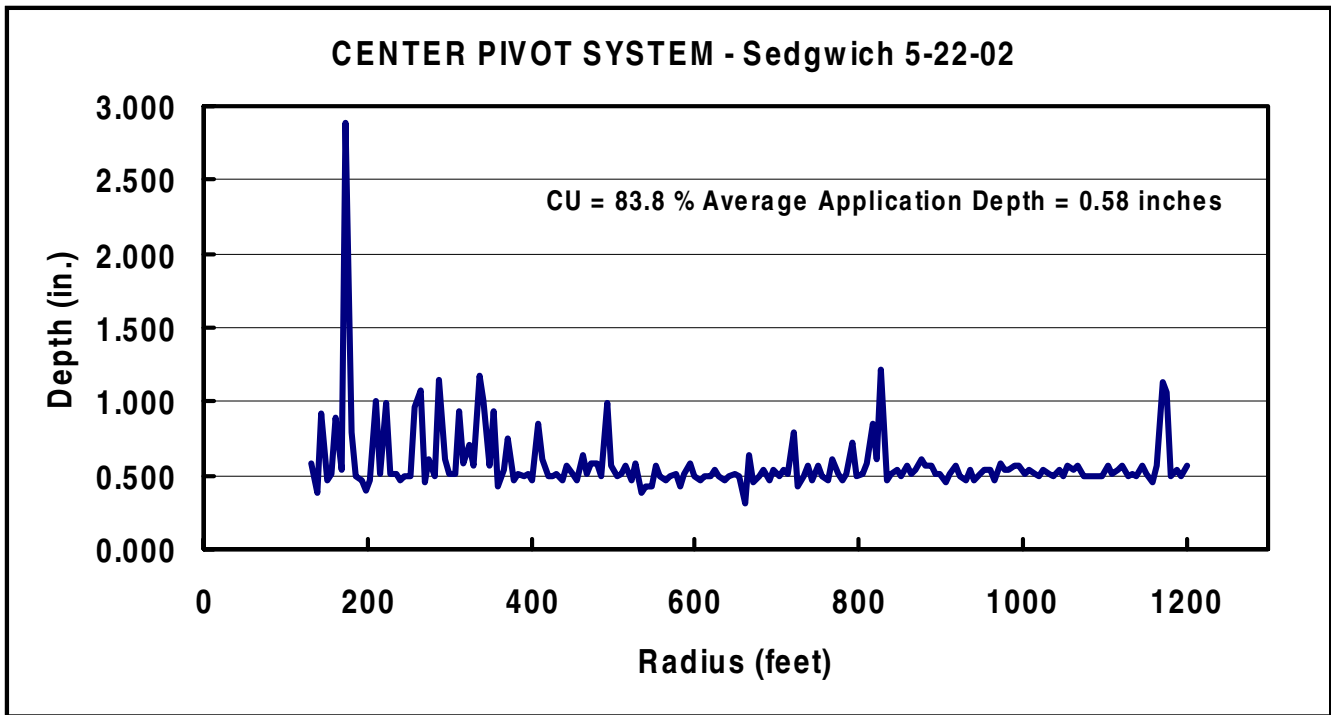


Figure 7. MIL uniformity test results for a center pivot equipped with rotator nozzles

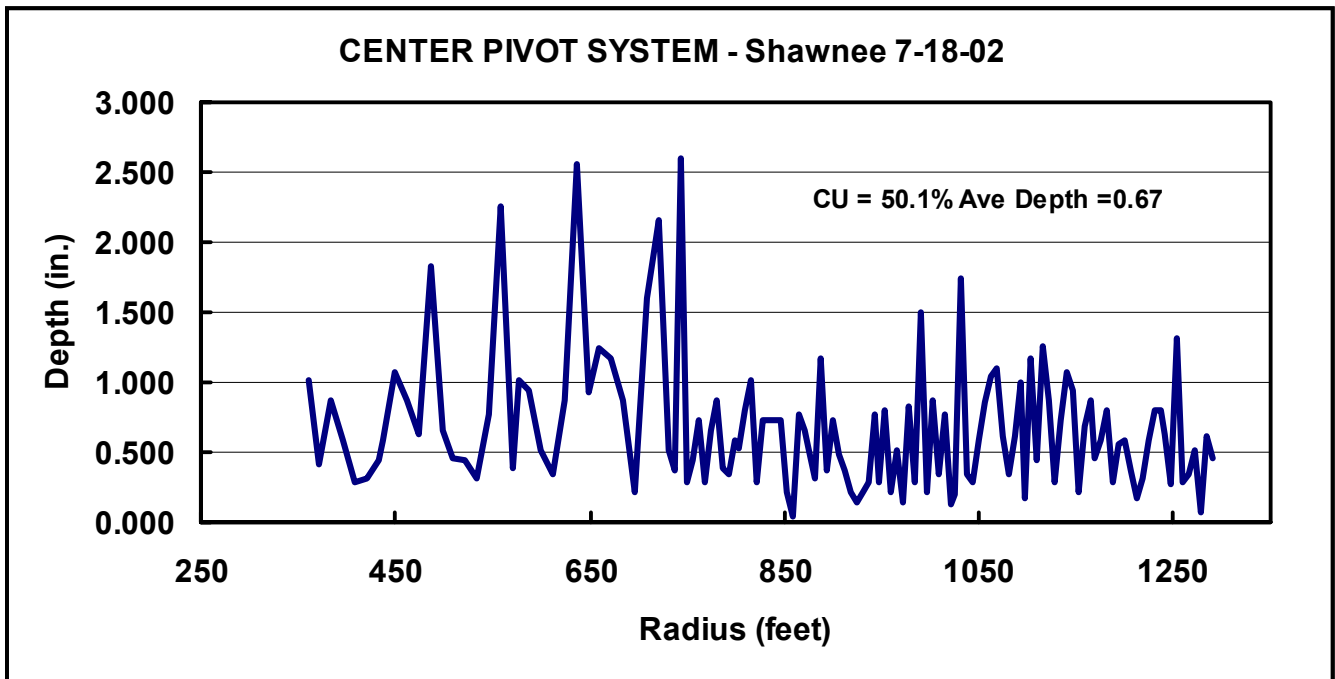


Figure 8. MIL uniformity test results for center pivot equipped with flat spray nozzles.

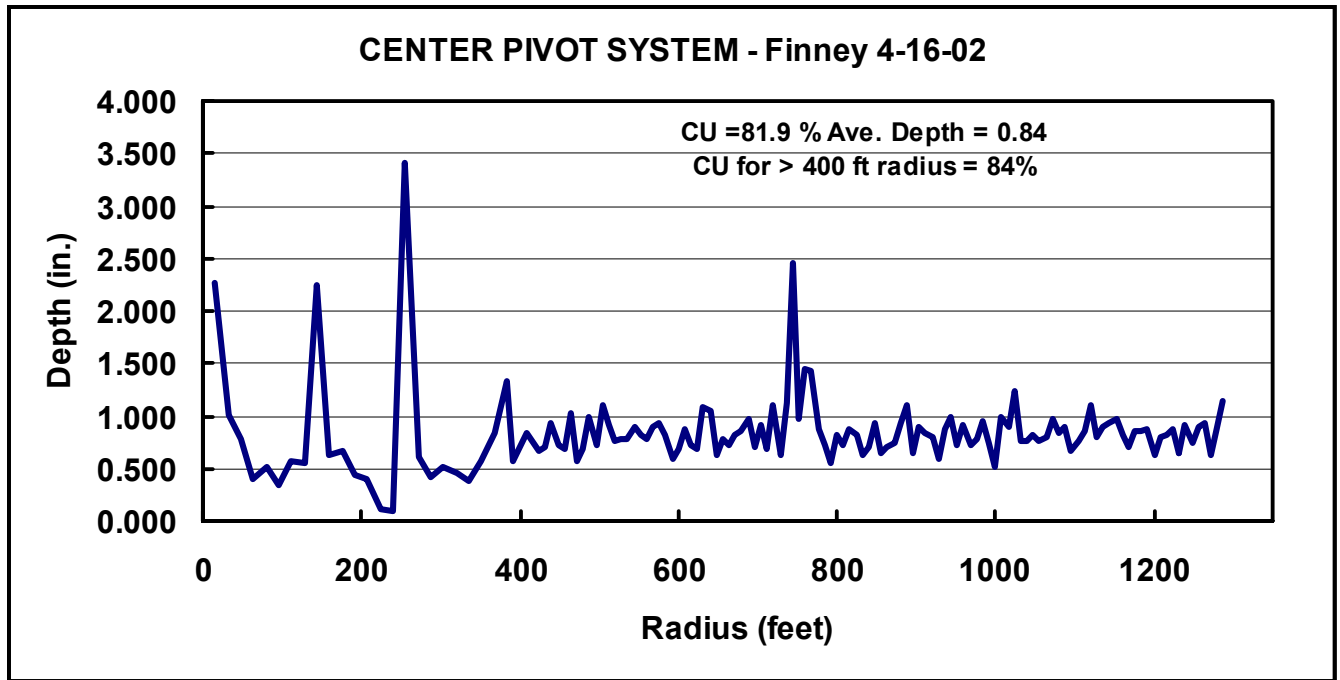


Figure 9. MIL uniformity test results for a center pivot equipped with flat spray nozzles.

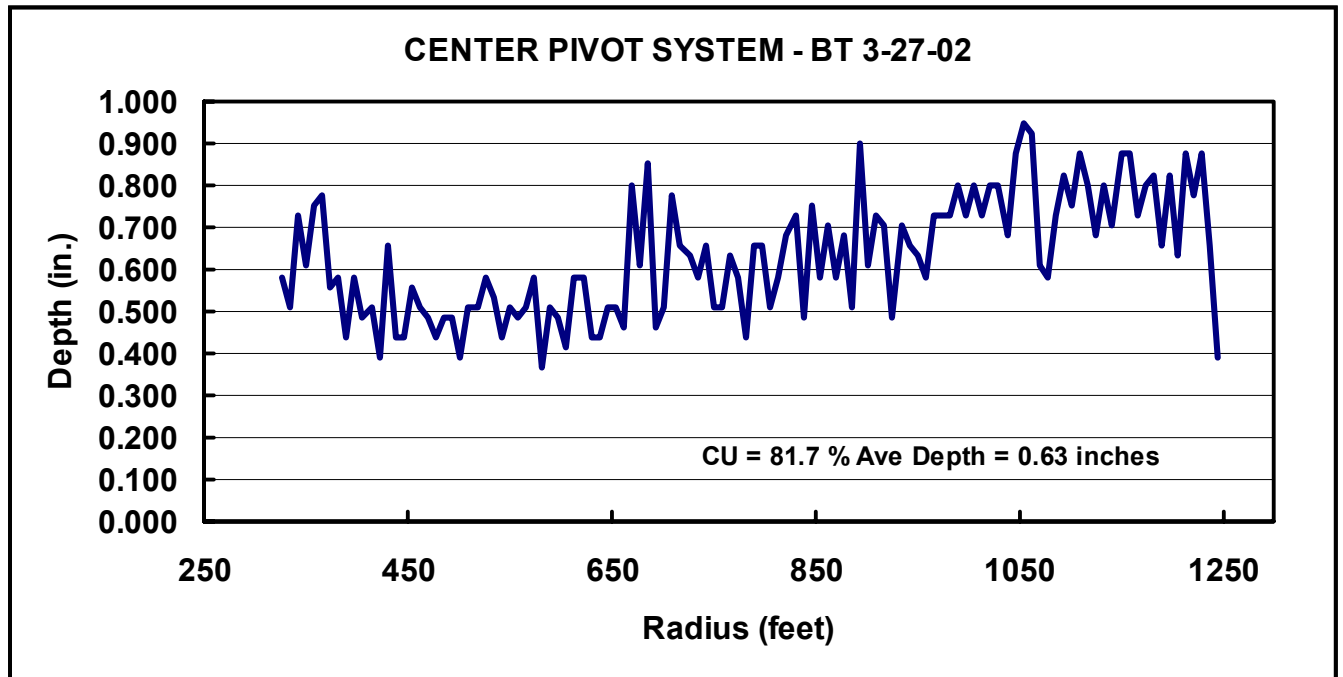


Figure 10. MIL uniformity test results for a center pivot equipped with I-Wob nozzles.