Matching the Nozzle Package to the Operating Conditions

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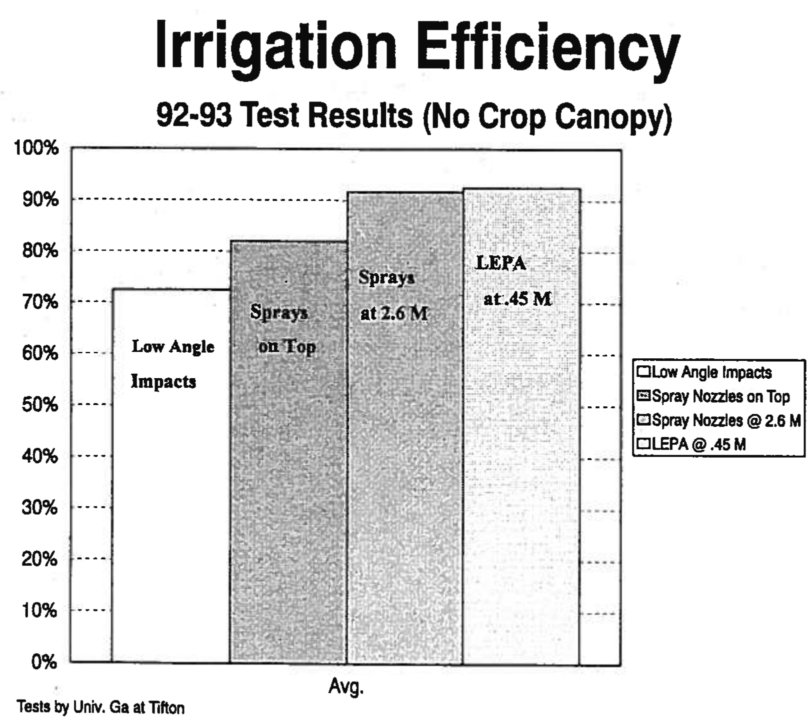
Sprinkler package selection for the center pivot has evolved over the years from wide spaced high angle brass impact sprinklers to a variety of sprinklers. The use of the high angle sprinkler has been replaced by lower operating pressure sprinklers with the majority being sprays, although low angle impacts made of both plastic and brass are still used in some supplemental irrigation areas. Some of the new sprays utilize rotating devices on closer spacing for improved uniformity that can be operated with energy saving pressures as low as 10 psi.

As these changes have taken place, the basic considerations become important. These include the soil conditions, terrain, and crop. When some soil and terrain conditions are grouped together a very careful review of the cropping practices, machine flow, and type of sprinkler selection become very critical for best operating and yield opportunities.

As the sprinkler type has been changing, another significant change has also been taking place. This involves using drops to lower the sprinkler from the top of the pipeline down nearer or into the crop canopy. Research has proven that this change can result in reduced evaporation and other losses related to wind drift. The guideline for this reduced evaporation is 1% gain for each foot of drop from the pipeline, up to a maximum of 10% water saving in some conditions.



intersection area between the infiltration curve and the application rate curve illustrates the "potential" runoff or surface water redistribution that might require surface storage from basin or reservoir tillage needed to reduce or eliminate runoff from LESA, LESA, or LPIC systems.

The type of sprinkler applicator and the mode of application determine the particular components of water losses. "Net" canopy evaporation may be in the 5-10% range. Overall evaporation losses in several cases were between 10-20%. Irrigation efficiency of LEPA systems without runoff were in the 93 -99% range, but without basin tillage LEPA systems in several cases had large runoff (or surface water redistribution) amounts. LESA or LPIC systems can be efficient with evaporative losses less than 10% in most cases, particularly with basin or reservoir tillage or with a no-till system.

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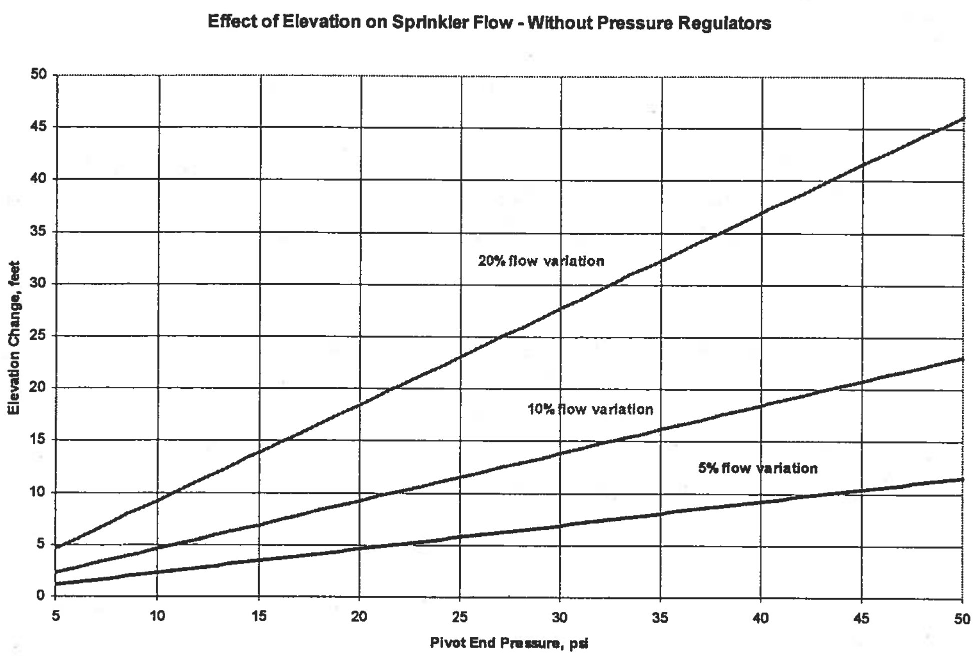
The proper design of the sprinkler package now must include many factors to provide proper distribution and prevent excessive runoff. Some of the factors are field slope, soil texture, crop canopy height, sprinkler pressure, and sprinkler type. With the adoption of low-pressure sprinklers the slope in the field can become extremely important, therefore the potential need for pressure regulators has become necessary. Generally a 10% variation in water applied is acceptable, therefore the positive and negative field elevation changes should be reviewed.



The lower pressure sprinklers now being used tends to have droplets that are of a size that is not as subjected to movement by the wind as some of the higher pressure units. Although if pressure regulators are not used and excessive pressure is applied to the low-pressure type sprinklers, small droplet can be formed. Various sprinkler types and pad configurations may modify the droplet, such as; deep groove pads produce larger droplets than shallow groove or smooth pads. Each pad type has characteristics that are suitable for the varying crop and/or soil conditions.

When drops are used, the sprinkler height must be coordinated with the crop canopy height, sprinkler type, sprinkler spacing and the drop type. The use and acceptance of the sprinklers placed on drops has grown rapidly. With that growth, various types of materials have been used. The first drop material used was galvanized steel pipe, followed by PVC, polyethylene, and flexible hose. The application of these materials depends on many factors.

The first item to consider when using drops is the material type and configuration of the device to deliver the water from the top of the machine pipeline and direct it down to the crop. Steel, aluminum and PVC "U" pipes or loops have been made to accomplish this task. These will have an offset ranging from 6 to 20 inches between the legs. The longer lengths allow the drop to be placed exactly between the row if desired, if the crop is planted in a circle. The "U"pipes are also made with configurations ranging from both male and female pipe threads to hose attachment barbs.

Galvanized steel pipe is used because it produces a rigid structure to mount the sprinkler. The use of steel drops and U-pipes continues to be a viable selection when corrosive water is not present. The length of these drops are generally limited to approximately nine (9) ft. above the soil surface, on standard profile machines, as the wind and crop may cause drop breakage if longer length pipes are used.

PVC drops and U-pipes have also been developed, because of lower cost of the material and their ability to handle corrosive water. The material is semi rigid and sunlight resistant that can withstand most environmental issues. The PVC U-pipe in conjunction with PVC provides increased flexibility when crop interference is encountered. Wind and cold temperatures can adversely affect the life of the threaded connections for this material.

Polyethylene drops, used with either steel or PVC U-pipes, has also become a popular choice in many areas, because of its relative material cost and durability. The material handles corrosive water extremely well and provides a semi-rigid structure. Polyethylene drops are generally black in color and the heat of the sun will cause the drops to bow slightly, depending on the temperature. This will cause the sprinkler to be offset slightly and can affect the pattern of the water.

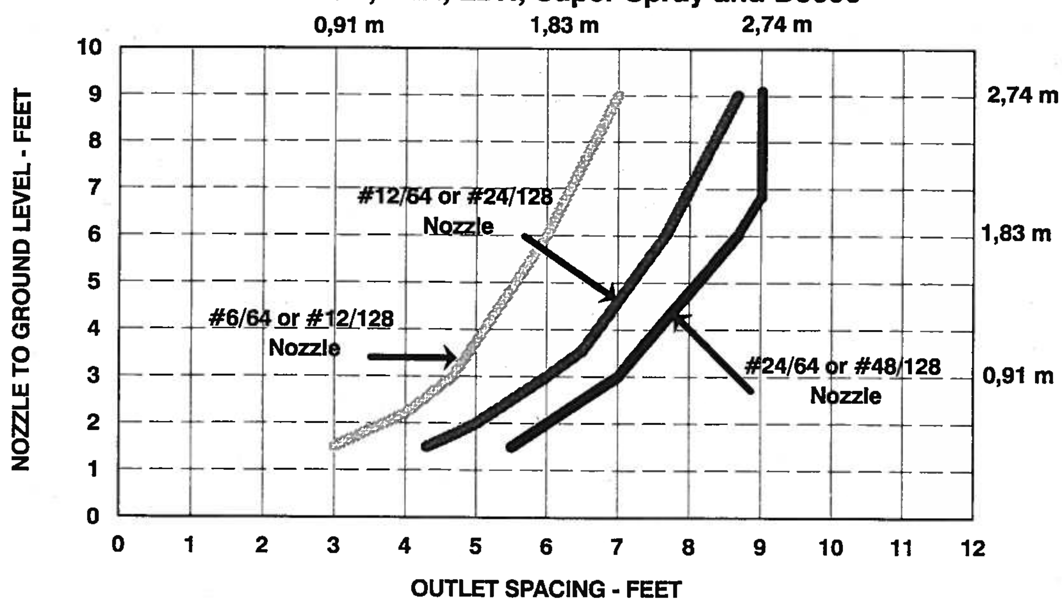
The use of flexible hose drops continues to expand. Flexible hose allows for lowering the sprinkler into the crop canopy for maximum application efficiency. The use of flexible hose also requires a weight to hold the sprinkler down and minimize the sprinkler movement in the wind. The weight must be added near the sprinkler to hold the hose straight and to assist in the prevention of the sprinkler being blown up over the truss rods in windy conditions. A variety of 1½ to 2 lb. weights are being used, ranging from pipe nipples to weights that slip over the hose made from pipe or various plastics. Weights of ¾ and 1 lb. that fit around or on to the sprinkler have been recently introduced which have a smaller surface area for less movement in windy conditions.

With the prevailing winds that are normal in this general area, the droplet size must be considered. The large droplet less movement is seen, although this droplet does not infiltrate into the soil as easy and it can also cause soil compaction of the soil surface. Low pressure can cause large droplets although there are pads and rotating sprinklers that can reduce the number of large droplets and yet produce a gentle application onto the soil and crop.
One of the more important design elements that must be considered is the sprinkler spacing when the unit is lowered near the soil surface. All sprinklers require adequate overlap from the adjacent sprinkler for uniform distribution.

As the discharge of each of the sprinkler types are lowered from the pipeline, the spacing distance between the sprinklers must be reviewed for proper overlap. The crop canopy will also affect the sprinkler overlap. A careful review using various tables and charts which show the proper ratio of spacing to height above the ground, types of pads, and drop material for a properly designed machine with sprinklers and drops to meet your field requirements.

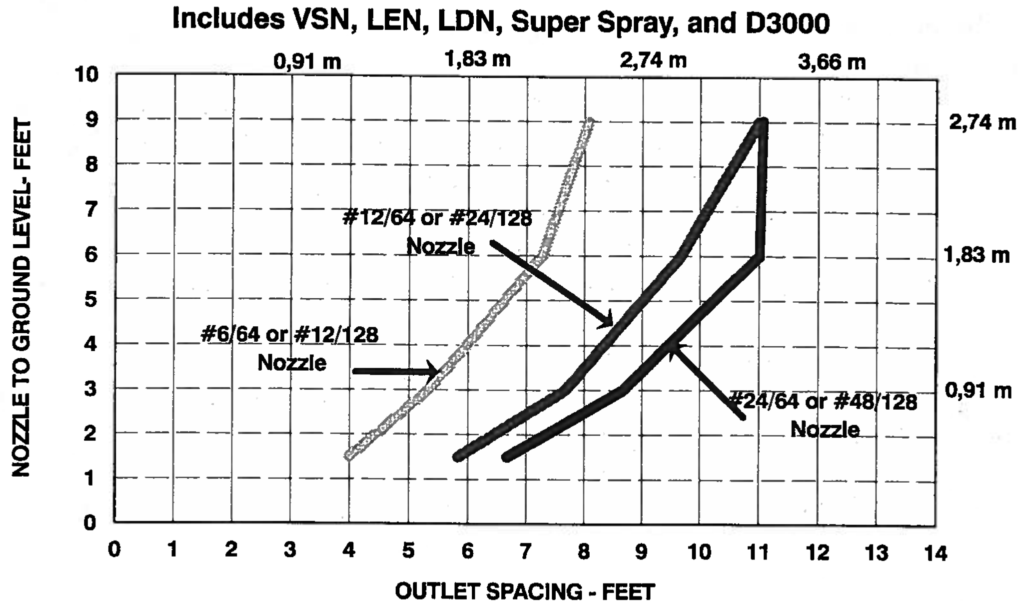
SPRAY NOZZLE SPACING at 6 psi (0,41 bars)

Includes VSN, LEN, LDN, Super Spray and D3000



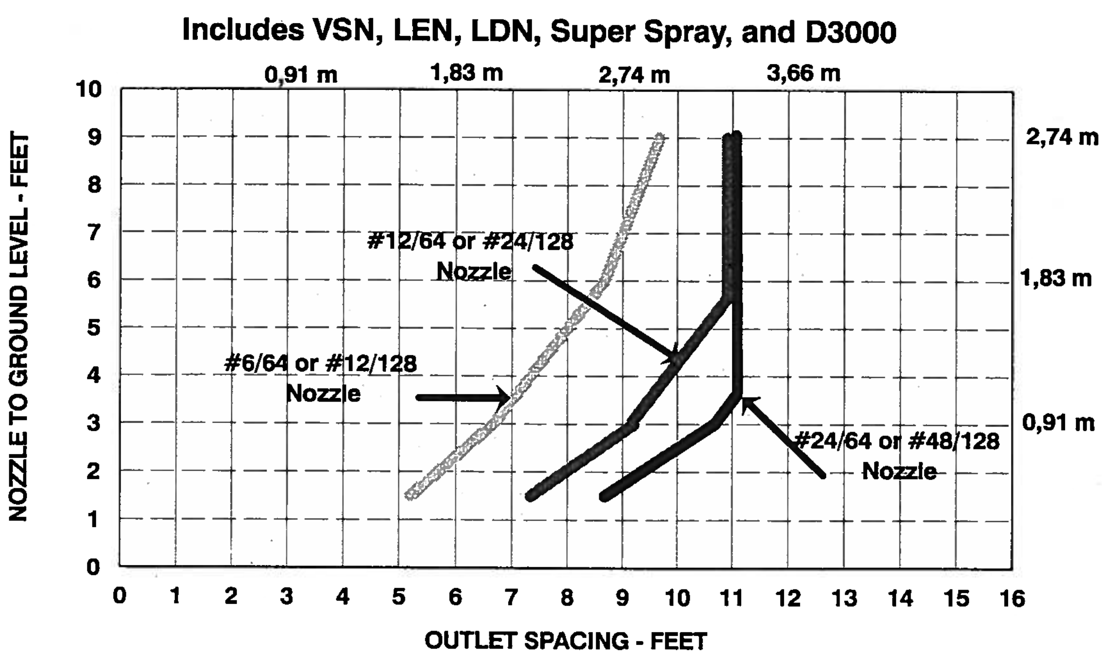
Flat Grooved Pad, no wind, 150% overlap

SPRAY NOZZLE SPACING at 10 psi (0,69 bars)



Flat Grooved Pad, no wind, 150% overlap

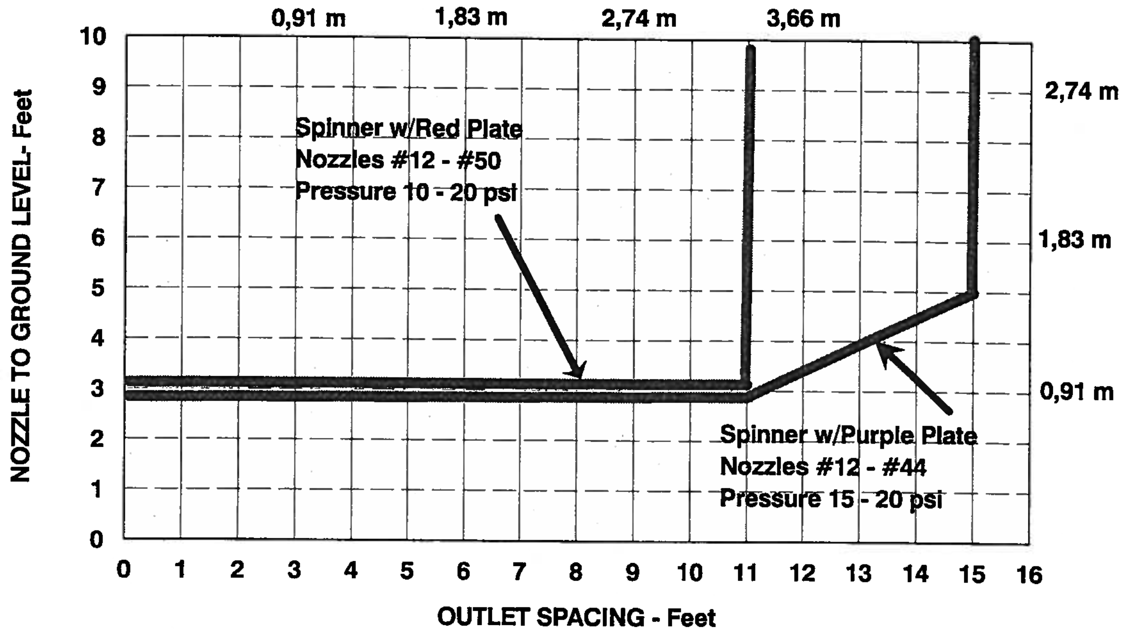
SPRAY NOZZLE SPACING at 15 psi (1,03 bars)



Flat Grooved Pad, no wind, 150% overlap

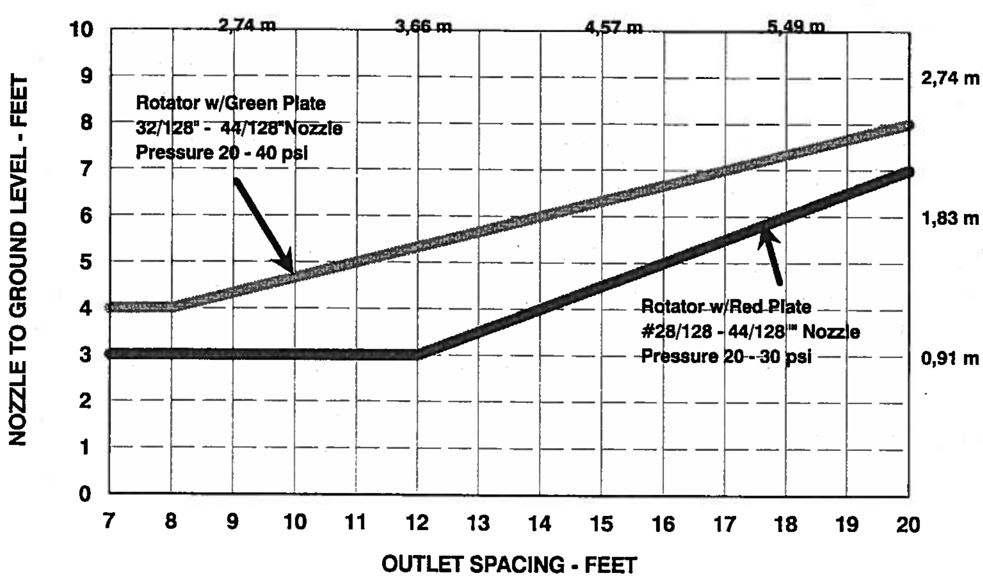
SPINNER SPACING

MAXIMUM



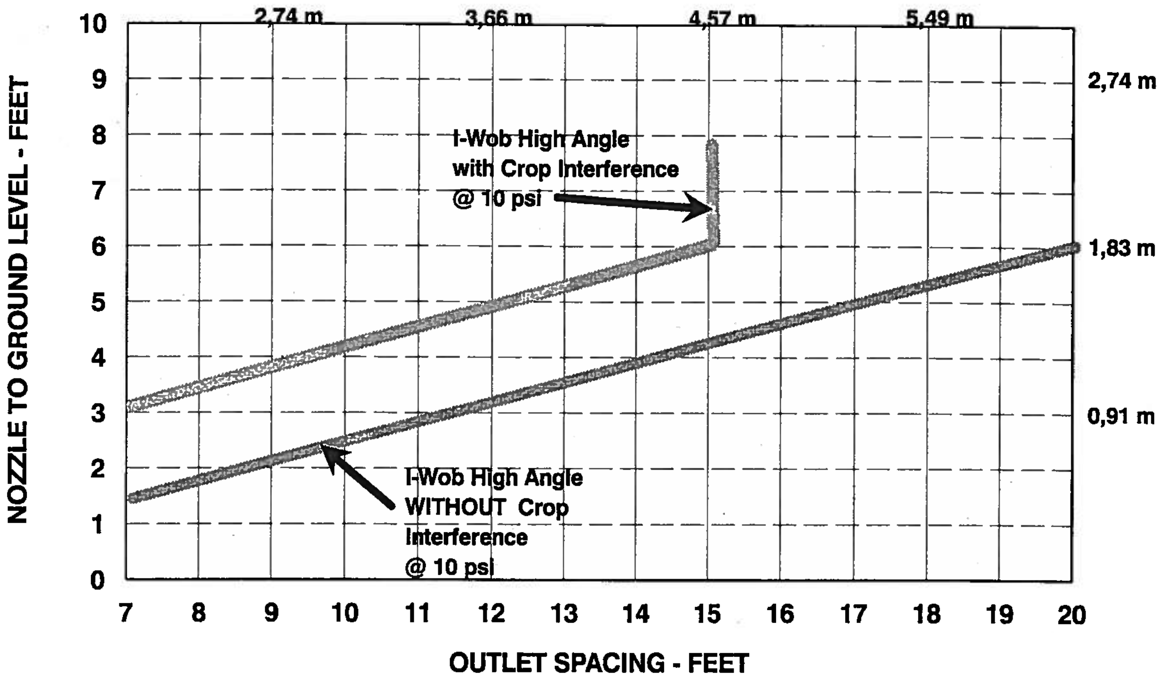
When nozzle is placed on drops 150% overlap

MAXIMUM ROTATOR SPACING



Spacing for maximum width should not exceed approximately 15% of machine length

MAXIMUM I-WOBBLER SPACING



Spacing for maximum width should not exceed approximately 40% of machine length SEE additonal graph
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The placement of the sprinklers very close to the soil surface has resulted in a concept commonly referred to as LEPA, or Low Energy Precision Application. The concept has resulted in measured application efficiency of up to 98%. The LEPA machines may be equipped with specially designed sprinklers, which are capable of only providing a bubble distribution or normal spray nozzles, which may be covered with a sock or tube for distribution directly into the furrow. On pivots, this usually involves planting the crop in a circle, whereas on linear machine, the furrow, are placed parallel to the wheel tracks.

The design of the sprinkler package may also include special methods and/or devices to keep the wheel track of the machine in a relatively dry area during the operation. This can involve using the drag sock or LEPA units adjacent to the wheels. Another method is to use boombacks or offsets, which are extensions behind the wheels in the direction of travel where 180° sprays are used, thus applying the water behind the wheels.

Upon the installation and/or after the initial or seasonal operation, it is important that you make checks concerning the sprinkler package. Ensuring that your sprinklers are operating at the correct pressure is one of the most important checks that you can make. Several items you will need are: 1) the correct sprinkler chart 2) accurate pressure gauges. Check the pressure at the pivot point and compare it to the value on the sprinkler chart. The pivot pressure must be measured at the top of the pivot elbow and compare it to the chart value. You should also check the pressure at the end of the machine or the last sprinkler. For both of the checks, the machine should be located so that it is at the highest point of elevation in the field and if it has an endgun, it should also be operating.

Checking the pressure is one of the most important items to check. If the sprinkler package is designed to operate at 20 psi at the end of the machine and it is only operating at 15 psi, a 15% reduction of water is being applied. In most locations pumping conditions can change throughout the growing season, therefore these pressure checks should be performed at least on a monthly basis.

In conclusion the initial design of the sprinkler package is extremely important, yet the operation and maintenance of the machine and sprinklers is also important, which can affect your crop yield and quality results.

MOBILE IRRIGATION LAB (MIL): Center Pivot Uniformity Evaluation Procedure and Field Results

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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. The front office area allows on-site training and data analysis opportunities. For larger training sessions, MIL computers are used in conference rooms to conduct hands-on computer software training. MIL tools include KanSched, an ET based irrigation scheduling program and FuelCost. A pumping plant efficiency estimator. The bulk of the field 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.

MIL Educational Activities

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