Offsets for Stationary Sprinkler Systems

Spacing between sprinklers is an important factor in providing uniform irrigation applications. Spacings tend to be made as wide as possible to reduce application rates and overall system cost. However, if spacings between sprinklers or lateral sets are too large, application uniformity goes down, creating overly dry and excessively wet spots in the field.

Converting to low pressure

Uniformity of water distribution is an important factor in stationary sprinkler systems, particularly when reduced-pressure operation is considered. Converting sprinkler irrigation systems from high or intermediate pressure nozzles (50 to 65 psi) to low pressure nozzles (about 35 psi) is a proven method of reducing energy consumption. Generally, this practice can reduce that portion of energy required to pressurize the water at the sprinkler nozzles by 15 to 25%. The sprinkler manufacturing industry has responded to this opportunity by developing suitable low-pressure nozzles for impact sprinklers used on stationary sprinkler systems. These nozzles are designed to operate at reduced pressures without the distribution problems encountered with conventional sprinklers at low pressure as shown in figure 1.

Reducing sprinkler pressure, while maintaining constant sprinkler discharge, does not change the system capacity to deliver water but does result in a reduced sprinkler pattern diameter and increased peak application rate. Consequently, because of the reduced pattern diameter, stationary system application uniformities may be reduced to unacceptable levels when attempting to reduce energy costs by lowering system pressure and not adjusting sprinkler spacing. Because of this reduction in uniformity, irrigators have been hesitant to convert side-roll or hand-move sprinkler systems to low-pressure nozzles. This type of problem does not occur on low-pressure conversions for center pivot or linear move sprinkler systems, although the sprinkler spacing on these continuous-move laterals must also be reduced to maintain high uniformity.

Rolling topography will cause greater deviations in flow rates of individual sprinklers on low-pressure systems than on high-pressure systems. The rule-of-thumb for high-pressure systems allows the pressure drop in a lateral to be 20% of the total pressure. With higher energy prices, allowable pressure variation is more critical to good flow distribution, thus the rule-of-thumb for systems should be a 10% allowable pressure drop. Uniformity problems in fields with large elevation variations can be eased by using pressure regulators. This will limit the energy savings because about 5 psi must be added to the system design pressure to operate the pressure regulators.

Offsetting laterals

A simple and inexpensive way to compensate for the low-pressure pattern reduction without changing spacing on stationary systems is to offset the sprinkler lines every other irrigation. The use of "offsets" or "swinglines" on low-pressure conversions can actually make possible a more uniform water distribution and crop yield than was originally obtained with the high-pressure nozzles on 40 × 50 foot or 40 × 60 foot spacings.

Lateral offset basically means that if the present valve or outlet spacing along the mainline is 60 feet, this same spacing is utilized after the low-pressure conversion is made as shown in figure 2. However, instead of always locating a lateral at the same takeout point on the mainline during every irrigation, a swingline is used to place it approximately midway between those points every other irrigation as shown in figure 2. For example, on the first irrigation, the irrigator places the laterals perpendicular to the outlets on the mainline. On the second irrigation, the sets are placed midway between the outlets of the mainline using the swingline to connect the laterals to the outlet valves. This simple practice will, in effect, reduce lateral spacing by one-half after two irrigations—enough to improve the cumulative uniformity of water distribution about 10% and reduce percolation loss approximately the same amount.

Offset sequencing

When side-roll systems require an odd number of wheel rotations (for example, 5 rotations to move 60 feet), it obviously is not possible to stop at 2½ rotations as the risers will be pointed towards the ground unless self-leveling sprinkler risers are used and are positioned horizontally on the side of the lateral. The other alternative is to stop the lateral at either two or three

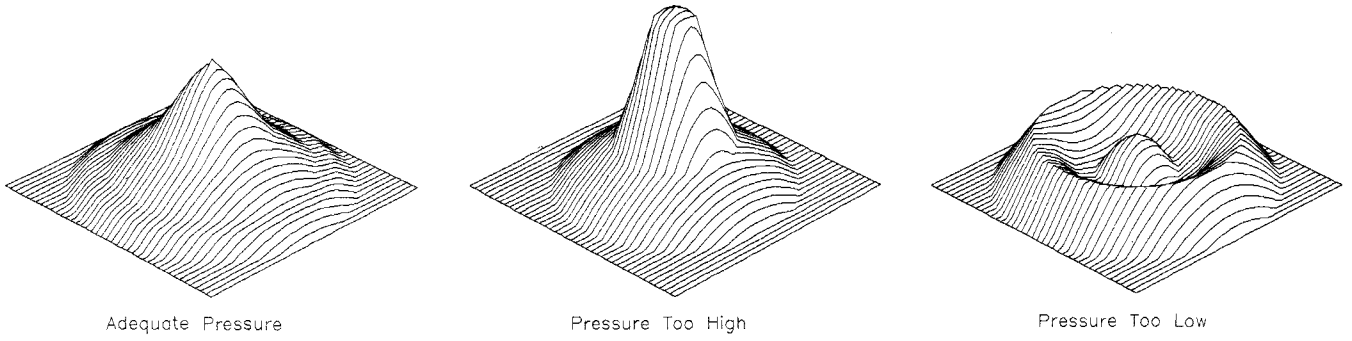

Figure 1.—Sprinkler nozzles must be operated at their design pressure to produce a proper distribution (left). Too high a pressure causes excessive breakup of the water stream, resulting in excess water application near the nozzle and a shortened throw radius to the outer perimeter (center). Too low a pressure produces the common wet and dry "doughnut" pattern in field (right).

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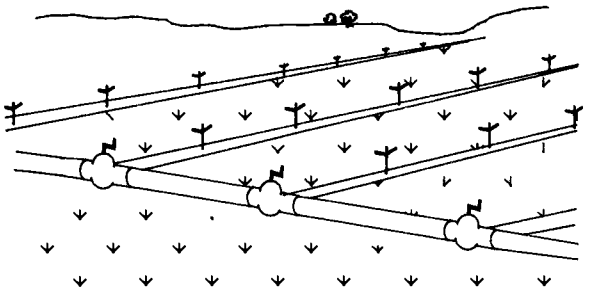

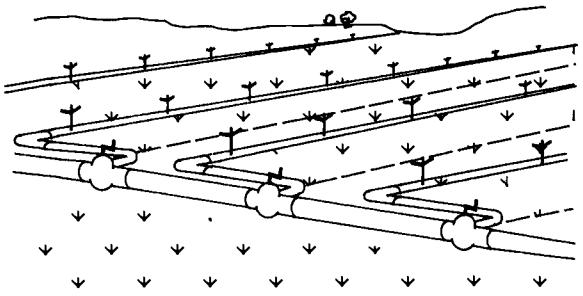

Figure 2.—Offset program alternates positioning of the lateral during every other irrigation. On odd-numbered irrigations (first, third, fifth, etc.), the lateral is placed directly out from the mainline valves as shown at left. On even-numbered settings (second, fourth, sixth, etc.), a swingline is used to position lateral midway between the mainline valves as shown at right. Thus, the total of two successive irrigations gives a more uniform distribution of water on the field.

revolutions to achieve the location of the first offset approximately midway between mainline outlet valves. From that point on, the lateral can be moved the five rotations with every set. Commonly-used wheel diameters and the approximate length of travel per revolution are: 46-inch, 12 feet; 58-inch, 15 feet; 64-inch, 17 feet; and 76-inch, 20 feet.

Offset advantages

The offset or swingline practice, used in conjunction with conversion to low-pressure operations, enables the irrigator to properly control water application and maintain an acceptable coefficient of uniformity (figures 3, 4, and 5). So doing will maintain approximately the same crop yield while reducing energy use. The uniformity improvement in water distribution from offsets or swinglines will be most significant on the larger moves (for example, 60 feet or more between outlet valves on the mainline).

It should be noted that the offset or swingline practice is beneficial with any type of stationary sprinkler system—side roll, hand move, or even big gun. It is a low-cost, low-labor method to substantially improve uniformity of water distribution and energy efficiency, but must be stringently followed if satisfactory results in crop yield and/or quality are to be expected.

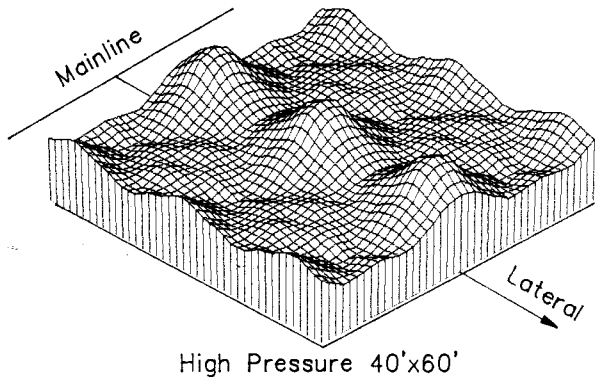

Figure 3.—Water distribution with normal pressure (50 to 65 psi) on a 40 × 60 spacing. System delivers water with a coefficient of uniformity of 80, about the minimum acceptable.

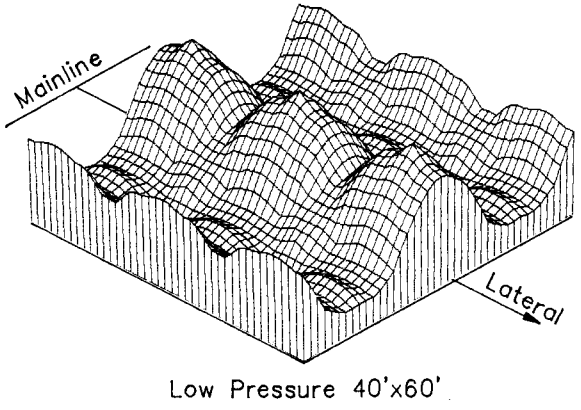

Figure 4.—Water distribution with low pressure (30 to 35 psi) on a 40 × 60 spacing. System delivers water with a coefficient of uniformity of approximately 50, an unacceptably low figure.

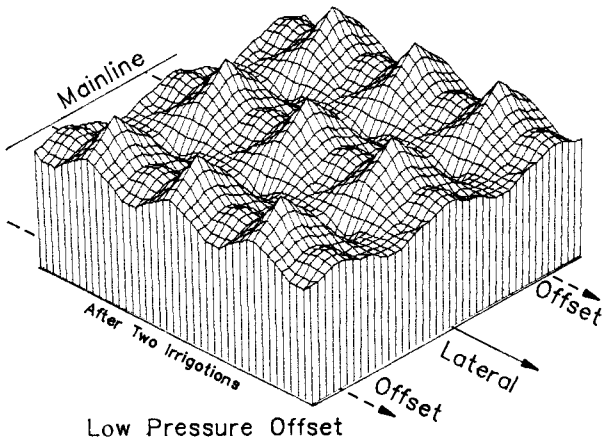

Figure 5.—Water distribution with the same low pressure (30 to 35 psi) on a 40 × 60 spacing but using offset every other irrigation. System performs with a very acceptable coefficient of uniformity of over 90.

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