

## Lawn Sprinkler Selection and Layout for Uniform Water Application <sup>1</sup>

A.G. Smajstrla, F.S. Zazueta and D.Z. Haman<sup>2</sup>

For efficient water application, lawn irrigation systems must apply water uniformly over the entire irrigated surface. High uniformity means that all parts of the irrigated lawn receive about the same amount of water. This requires proper sprinkler selection and layout. Sprinkler patterns of coverage must overlap to provide uniform water application, and pressure must be adequate to provide proper sprinkler operation and water distribution. The layout must direct water into the irrigated zone, but prevent overspray beyond the irrigated zone onto surrounding streets, sidewalks, buildings, or other property.

Lawn irrigation systems can often be subdivided into approximately rectangular subunits or zones. Thus, this publication will address the problem of efficiently irrigating square or rectangular land areas with sprinklers which have circular patterns of water application.

### SPRINKLER WATER DISTRIBUTION

The pattern of water distribution from a sprinkler is commonly a circle or part circle. Most manufacturers make sprinklers that are easily

adjusted to apply water to a complete circle or to almost any portion of a circle. Some sprinklers are pre-set in commonly required patterns such as 90° (quarter-turn) for corners and 180° (half-turn) for the sides of irrigated zones. Figure 1 shows typical sprinkler patterns of water application.

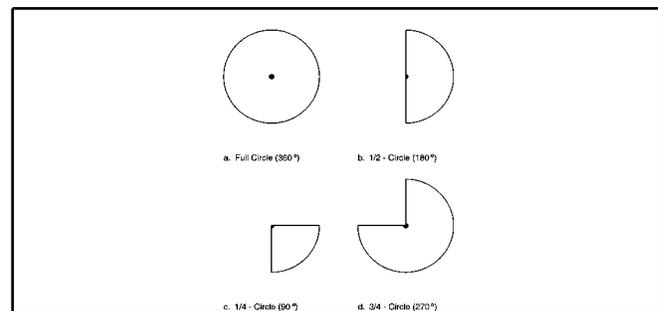


Figure 1 .

The rate of water application from a sprinkler is typically greater near the sprinkler and lower farther from the sprinkler. A very common water distribution pattern is triangular as shown in Figure 2a . Actual sprinkler water distribution patterns will vary from the ideal triangular pattern shown, however, the triangle is an adequate approximation

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2. A.G. Smajstrla, Professor, Agricultural and Biological Engineering Department; F.S. Zazueta, Professor, Agricultural and Biological Engineering Department, and D.Z. Haman, Associate Professor, Agricultural and Biological Engineering Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.

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for most cases. The actual patterns can be obtained from the sprinkler manufacturer.

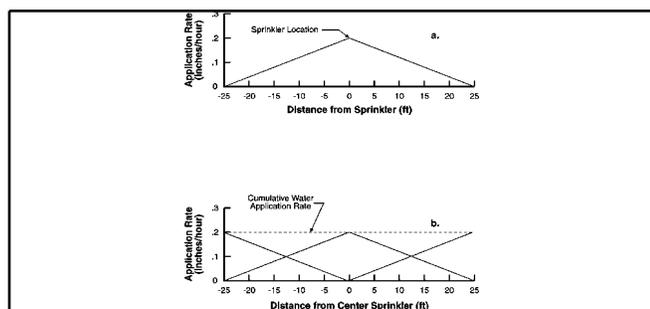


Figure 2a .

The sprinkler in Figure 2a has an application rate of 0.2 inches per hour near the center of the pattern, but that rate drops to zero at a distance of 25 ft from the sprinkler. This figure shows why sprinkler patterns of coverage must be overlapped in order to obtain uniform applications. If this single sprinkler was allowed to operate for 1 hour, 0.2 inches of water would be applied near the center of the wetted circle, but that amount would decrease as the distance from the sprinkler increases. As a result, some of the lawn near the sprinkler might be adequately irrigated, but the lawn far from the sprinkler would almost certainly not receive enough water, and uniformity would be poor.

To uniformly apply water with a sprinkler irrigation system, the sprinklers must be spaced so that the water overlaps from one sprinkler to the next ( Figure 2b ). If the sprinklers are spaced so that the overlap is approximately equal to the radius of coverage (25 ft in this example), then the resulting cumulative water application rate and depth will be uniform. The dashed line in Figure 2b shows the effect of the overlap from three sprinklers which have individual water application patterns as shown in Figure 2a . In this case, the cumulative water application is very uniform because the water distribution patterns were assumed to be perfect triangles. In actual systems, the cumulative water application will likely not be this uniform because the water distribution patterns are not perfect triangles.

## SPRINKLER LAYOUT

To apply water uniformly to square or rectangular land areas with circular sprinkler distribution patterns, sprinklers must be laid out as

shown in Figure 3a . In this figure, the land area is a square, and the sprinkler selected has a radius of coverage that is 1/3 of the length of a side of the square. This selection requires 16 sprinklers to uniformly irrigate this area. To uniformly irrigate the corners of this lawn requires four 1/4-circle sprinklers. To uniformly irrigate the boundaries requires eight 1/2-circle sprinklers, two along each side. To provide proper overlap in the center of the lawn requires four full-circle sprinklers.

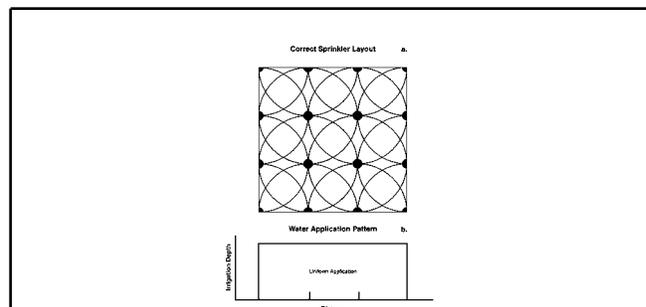


Figure 3a .

Figure 3b shows the expected water application pattern across the irrigated zone. If sprinklers and flow rates are properly selected, the water application will be very uniform within the irrigated area as shown. If all sprinkler angles are properly adjusted, then water will only be applied up to the edge of the lawn, avoiding overspray onto surrounding streets and sidewalks.

To obtain high uniformity of water application onto square or rectangular land areas with circular sprinklers requires the use of part-circle sprinklers along the edge of the lawn. This rapidly increases the number of sprinklers required because each of the border sprinklers irrigates a smaller land area than the center sprinklers. To reduce the system cost, some systems are installed with fewer sprinklers. However, the initial cost savings from doing this is poor economy because the nonuniform water application will result in inadequate irrigation, waste of water, or both.

Figure 4 illustrates an attempt to greatly reduce the number of sprinklers required to irrigate, without overspray, the lawn shown in Figure 3 by eliminating all part-circle sprinklers. It can easily be seen that it is impossible to uniformly irrigate this area without using part-circle sprinklers on the border. In fact, the corners of the lawn will receive no irrigation at all.

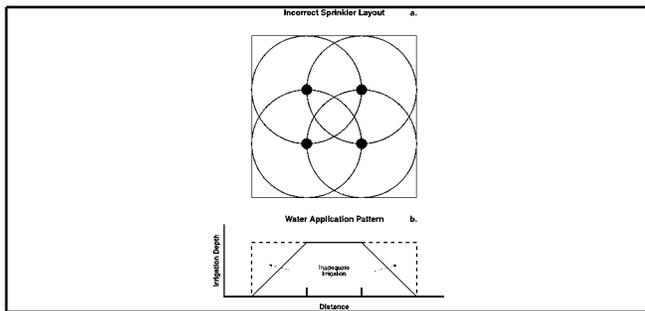


Figure 4 .

Figure 5 illustrates an attempt to reduce the number of sprinklers required to irrigate the lawn shown in Figure 3 by using only full-circle sprinklers but allowing overspray onto surrounding areas. The resulting water application pattern will be uniform only between the sprinklers. Irrigation will be inadequate near the lawn boundaries, and water will be wasted from overspray. With this design, the uniformity can be increased by moving the sprinklers nearer the boundaries, but this will also increase the amount of water wasted by overspray.

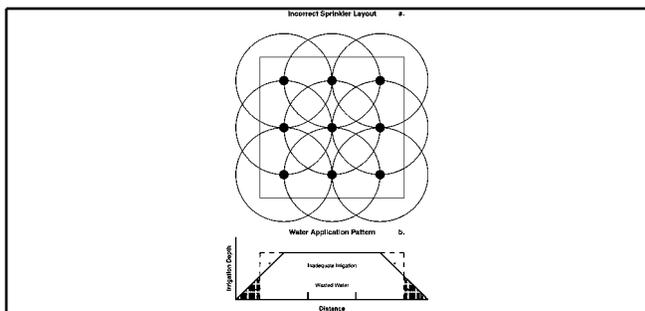


Figure 5 .

Often homeowners must irrigate long narrow strips of lawn. The correct sprinkler layout for long, narrow lawn areas is shown in Figure 6a . Part-circle sprinklers should be used to border the area and spray toward the center. As shown in Figure 6b , poor uniformity and inadequate irrigation will result from placing the sprinklers in a single line down the center of the strip if overspray is to be avoided. Poor uniformity and the waste of water will result from allowing overspray if sprinklers are placed in a single line down the center of the strip of lawn ( Figure 6c ).

When part-circle sprinklers are placed along the edge of a lawn next to a street or driveway, the sprinklers can easily be damaged by vehicle traffic. To avoid this problem, the sprinklers can be moved

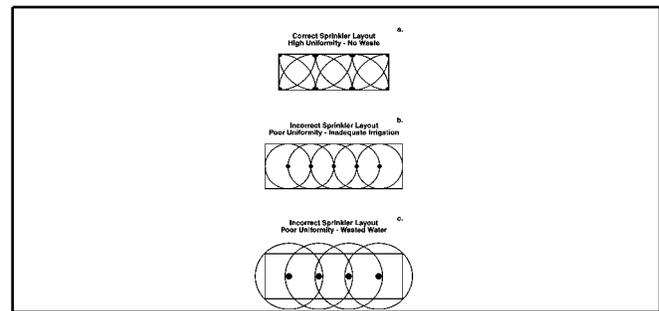


Figure 6a .

away from the edge of the driveway a short distance (2-3 ft) into the lawn. Then the sprinkler angle of coverage can be set slightly larger to cover the area near the driveway, without significantly reducing the uniformity of water application. Also, always use flexible connectors on sprinkler risers so that pipes will not be broken by occasional vehicle traffic. Flexible connectors will also make it easier to keep sprinklers upright and to make repairs that might occasionally be necessary.

## SPRINKLER SELECTION

To achieve uniform water applications from a combination of part and full-circle sprinklers as shown in Figure 3a requires that the sprinkler flow rates be appropriate for the pattern of water distribution. Since a 1/2-circle sprinkler irrigates only 1/2 of the land area as compared to a full-circle sprinkler with the same radius, then the flow rate of the 1/2-circle sprinkler must be only 1/2 of the full-circle sprinkler flow rate. Likewise, the flow rates of each of the other part-circle sprinklers must be matched to their areas of coverage. For example, a 1/4-circle sprinkler must have 1/4 of the flow rate of a full-circle sprinkler, etc.

The application rates of part-circle sprinklers are matched to the full-circle rate by changing the sprinkler nozzle size. Manufacturers provide charts which give sprinkler flow rates with different nozzle sizes and operating pressures. Most also provide lists of matched sprinklers for common angles of coverage. In general, however, if the flow rate is to be reduced by 1/2, then the nozzle cross-sectional area must be reduced by 1/2. Since the cross-sectional area depends on the square of the diameter, reducing the nozzle diameter by 1/2 will reduce the flow rate to approximately 1/4 of the original flow rate.

## SUMMARY

To achieve high uniformity and efficiency in sprinkler irrigation of lawns, the irrigated areas should be surrounded with part-circle sprinklers, directed toward the center of the irrigated area. It is not possible to avoid overspray and uniformly irrigate a lawn with only full-circle sprinklers located within the lawn area. Overspray and the waste of water will occur if full-circle sprinklers are used near the edge of a lawn.

When part-circle sprinklers are used in irrigation systems, their flow rates must be adjusted by proper nozzle selection to be consistent with the sprinkler area of coverage. It is false economy to purchase a poorly designed sprinkler irrigation system because either water will be wasted or the lawn will not be adequately irrigated, or both.