Sprinkler and Lateral Spacing

distribution of irrigation water applied by sprinklers improved by proper spacings of sprinklers and laterals

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Results of recent field tests indicate the extent wind—and sprinkler and lateral spacing—influence the uniformity of water distribution from medium capacity sprinklers.

Winds in excess of 6 mph—miles per hour—have a decided influence on water distribution. In fact with the spacing used with some sprinklers and laterals, the water reaching the soil in parts of the area between sprinklers is only 10%–15% of the amount the system was designed to apply. Such water distribution results in a severe soil moisture deficiency and a reduction in crop yield.

Improved water distribution can be obtained under windy conditions by closer spacing of sprinklers and laterals. Medium capacity sprinklers at 30' spacing gave the best distribution with a greater range and choice of lateral spacing.

However, certain limits of closer spacing must be considered, including the increased initial cost for more equipment and more labor cost required to move the closer laterals and sprinklers. These factors along with others—such as the maximum water infiltration capacity of the soil—should be considered in the design of a well planned sprinkler irrigation system.

The effect of wind on water distribution can be determined by tests using specially designed collection cans spaced around the sprinklers on a given grid pattern and analyzing the distribution from the amounts of water collected in the cans. The results obtained are usually expressed as coefficients or distribution percentages.

The most commonly used statistical method is the uniformity coefficient expressed as a percentage on a scale of 0%–100% with 100% indicating absolutely uniform distribution over the entire area covered by the water discharging from the sprinklers. A uniformity coefficient of 80% is generally considered to be the lower limit of acceptable distribution.

A single lateral line was used in an initial series of experiments performed within certain ranges of wind velocities. The number of sprinklers on the lateral varied depending on the spacing required to give complete overlap in the collection area. By a method of superimposing the data from all of the collection cans it was possible to use the amount of water at any collection point for a number of different spacings. Also, the time required to perform a run was reduced, providing certain precautions were taken.

A plot of the uniformity coefficient for 30' sprinkler spacing by 30', 40', 50' and 60' lateral spacing—when the sprinklers operated at 30 pounds per square inch—is shown in the following graph. There is little effect on the uniformity coefficient for different spacings at the low wind velocities. However, above 6 mph the uniformity coefficient falls off very rapidly. For velocities of more than 12 mph there is not a great difference up to the wind velocities measured in these experiments. Similar data for sprinkler spacing of 40', 50' and 60' operating at the same pressure were obtained with an increase in sprinkler spacing. A more pronounced decrease in uniformity takes place with increasing wind velocity.

These results established a trend that by decreasing the sprinkler spacing the uniformity of distribution could be improved providing the lateral spacing was constant. From the standpoint of labor required to move the pipe, this is very satisfactory. The wider the lateral spacing the less will be the labor required to move the lateral. In many cases the labor requirements and the cost of moving are the major operating cost of the sprinkler system.

A summary of all the tests performed at 30 pounds per square inch, showing the influence of increasing lateral and sprinkler spacing on uniformity of distribution with increasing wind velocity are shown in the two graphs in this column.
30’ would be satisfactory with wind velocities up to 7-8 mph. In all cases, the closer sprinkler and lateral spacings were most satisfactory.

<table>
<thead>
<tr>
<th>Sprinkler</th>
<th>Lateral</th>
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<tbody>
<tr>
<td>20’</td>
<td>X 40’</td>
</tr>
<tr>
<td>30’</td>
<td>X 50’</td>
</tr>
<tr>
<td>40’</td>
<td>X 60’</td>
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<tr>
<td>60’</td>
<td>X 80’</td>
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To evaluate the importance of sprinkler and lateral spacings on distribution under actual field conditions, nine different combinations of sprinkler and lateral spacings were tested during the summer of 1956. The spacing combinations are shown in the next column.

All the laterals were operated simultaneously except for a small difference in time required because of slightly different application rates. At the end of each run, the necessary measurements were made, the lateral moved and the process repeated. This procedure required two days of operation for four lateral positions and was carried out on a 24 hour basis—two day and two night runs.

A test plot was established between the second and third lateral positions for each lateral and sprinkler spacing and equipped with collection cans set on a 10’ grid pattern and read at the end of each period of operation.

The rates of discharge of the sprinklers were determined periodically by volumetric measurements. Pressures were maintained by careful regulation and use of calibrated pressure gages. Records of temperature, humidity, wind direction and velocity were obtained for all test periods.

During five irrigations the average wind velocity did not exceed 7.2 mph for any 24 hour period. During most of the periods of water application wind velocity varied from 2-5 mph and from essentially the same direction. The maximum daytime temperature was 98°F. The nighttime temperature varied between 57°F and 64°F. These weather conditions were typical for summertime in the test area. It was not exceptionally windy or hot.

Data for two of the irrigations with different average wind conditions are shown in the following table. A direct comparison of the uniformity coefficients for all spacing combinations shows a significant decrease in uniformity when the wind velocity increased from 2.8 to 6.4 mph. This information confirms the reliability of results obtained by shorter single lateral tests.

$$\text{Uniformity Coefficient - Percent}$$

<table>
<thead>
<tr>
<th>Wind velocity avg. per irrig.</th>
<th>Sprinkler Spacing</th>
<th>Lateral Spacing</th>
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<tbody>
<tr>
<td>2.8</td>
<td>94, 93, 93, 93</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>81, 75, 77, 77</td>
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</table>

To evaluate the performance of the different spacings results were plotted as a relationship between the uniformity coefficient and a spacing coefficient. The spacing coefficient is a numerical expression computed by dividing the square root of the area within the sprinkler and lateral spacing by the sprinkler diameter throw. The graph on this page shows that in general the greater the spacing coefficient or area between sprinklers and laterals, the lower will be the uniformity of water distribution.

Specifically, the uniformity for the 30’ sprinkler spacing by 40’, 50’ and 60’ lateral spacings are quite similar. In fact, there is essentially no difference between any of these lateral spacings for the type of sprinklers used in these tests. Essentially the same results were obtained for the 40’ by 50’ and 60’ lateral spacings.

Sodium may be toxic to certain plants. This element is usually accompanied by the chloride ion and either one or both may cause burning or death of leaves in lemons, oranges, almonds, apricots, peach and walnuts. Beans and potatoes are also sensitive to these elements. Burning and killing of plant leaves is not necessarily associated with a high salt concentration in the soil, for upon analyses no high concentration of salts is found, and many times it is quite low.

Recently, work has indicated a sulfate toxicity to certain strains of lettuce and romaine. Earlier this was known as Brown Blight, which occurs principally...