(3) Encouraging the fabrication of raw materials within the region.

(4) Encouraging Southeastern Ohio capital to invest in Southeastern Ohio's future.

4. Develop overall economic development projects for specific regions within the SEORC area.
5. Promote community improvement programs.
6. Assist in establishing a technical training center for the area to provide vocational training for youth and vocational retraining for adults.
7. Establish an industrial site committee.

Recommendations for Procedure

1. Establish an organizational structure as outlined in the Constitution of the Council.
2. Determine long range goals utilizing the entire membership to establish and to attain these goals.
3. Develop the philosophy that membership must be on a sustained basis.
4. Publicize committee activities to keep public interest alive.
5. Have self-paying projects once a year to keep member-interest alive.
6. Utilize the membership to write the program of work.
7. Select an important but relatively easy project to accomplish. Work diligently on this project to insure its success. Publicize the results.
8. Maintain adequate records of all Council meetings and activities.

CRITERIA FOR SPRINKLER OPERATION

By

Winston C. Strong

Professor, Soils and Irrigation
Fresno State College
Fresno, California

Young cotton grown under sprinkler irrigation emphasizes the need to design and to operate sprinklers correctly. The damage to small plants that was first reported as "summer frost" is not due to sprinkler irrigation per se but is due to improper operation of the sprinklers.

There are a number of factors usually present when damage occurs:

1. The cotton is young and much bare ground is exposed.

2. The weather is windy and often warm.

3. The soil and/or the water may be alkaline or saline .

4. The pressure at the nozzle of the sprinkler is below the recommended optimum for the breakup of the nozzle stream.

5. The rate of the rotation of the sprinkler is too slow.

The first three conditions are beyond the control of the farmer and he has to get along with them when they occur. The last two conditions are operational and can be changed by the farmer or the designer of the sprinkler irrigation system. Before deciding what new design conditions should be met or what changes should be made in an existing system to bring it into proper operation, it is important to know what damage is being done and why it occurs.

The first type of damage to consider is a physical phenomenon in which the young cotton plant is virtually smothered. This suffocation is due to a capping of the soil surface that prevents oxygen in the air from entering the soil and carbon dioxide in the soil from escaping into the air. This lack of gas exchange alone would be sufficient to create the damage observed, but also contributing to the damage may be salt burn, often an additional sealing action due to sodium salts, and lastly, mechanical damage to the young plant.

It is possible to explain why such damage occurs. The sprinkler with inadequaute pressure creates large drop sizes; these hit the ground with great energy, tending to break down the desirable granulated soil structure into a puddled state to form a sealing cap on the surface. Five to ten pounds of additional nozzle pressure will reduce the average drop size considerably and cut the energy of impact on the soil. The importance of drop size can be evaluated from the following: a 5 mm drop size application of water will hit the soil with over 71 times the impact of an equal application composed of 1 mm drops. The reduction of the average drop size from 2 mm to 1 mm would reduce the energy of impact by 3 times. However, we are not primarily concerned with averages but with the energy of impact in certain locations in the overall sprinkler pattern and the duration of this energy. If the energy impact on a given area lasts for several seconds at a time it can do much more damage than if it lasts for a fraction of a second at a time, even though the total impact time on any spot is the same over an hour's span. This fact stresses the importance of adequate speed of rotation of the sprinkler. Another reason for proper speed is the fact that a more uniform coverage is achieved with a sprinkler turning with adequate speed. The slow turning sprinkler tends to put down water more unevenly and what is worse, it adds to the damage by applying this excess water in the areas of largest drop sizes.

Another important factor is the terminal velocity of the various size drops. To refer again to the 2 mm and 1 mm drop sizes, the terminal velocity of the 2 mm drop is 21 feet per second whereas the terminal velocity of a 1 mm drop size is approximately 12.5 feet per second. The bigger droplet given added thrust and an increased angular direction by the wind is more erosive, and carrying abrasive materials greatly increases the damage to the young plant.

The importance of proper pressure has been recognized by many designers and operators of sprinkler systems for some time and the items mentioned so far are a review of some of the factors related to pressure. An additional point is that proper pressures give much more uniform coverage of precipitation. In this respect it has more effect than the speed of rotation.

Now let us consider further the speed of rotation, a factor that has not been given sufficient attention. Besides improving the uniformity of coverage and lessening the intensity of energy impact, the faster turning sprinkler has other assets. For one thing the water is given additional breaking up action from the rotational speed of direction as opposed to nozzle pressure thrust direction. This side-wise breakup substitutes in some measure for lack of pressure. Thus if pressures are low, speed of rotation is of increasing importance to achieve breakup of the water stream and to improve uniformity of coverage. The side action and additional breakup reduces the diameter of throw slightly and greatly reduces the terminal velocity and energy impact. Speed of rotation is important where saline water is used. Slow rotation allows the salt to build up on the leaf surfaces. This salt concentration is absorbed into the leaf creating salt excesses internally as well as salt residues on the exterior leaf surfaces. When sprinklers turn faster, this salt buildup is prevented by the salt being kept washed off of the leaves. On microclimatic control, both for cooling and frost prevention, the frequent wetting action of the faster-turning sprinkler is highly desirable.

Equal protection against freezing achieved with 33% less water when sprinkled water is applied every 60 seconds as compared to 120-second application. If equal amounts of water are applied, for instance 1/10th of an inch an hour, the sprinkler that turns in 60 seconds will provide protection to the crops on which it is applied of approximately 4°F colder temperatures, than the sprinkler turning every 120 seconds.

What can the farmer do when he discovers too little pressure at the nozzle or sprinklers that turn too slowly? If the farmer has a variable power source he can increase the HP input. On the other hand by reducing the gallonage output he can also increase the pressure. Gallonage can be reduced sometimes by dropping a line or by changing from two-nozzle sprinklers to one nozzle or by reducing nozzle sizes. Great care needs to be exercised in any change since basic design principles may be violated. It would be well to call in the design engineer of the dealer or distributor that originally set up the irrigation system. The turning rate of the sprinkler can be changed by adjusting the spring tension on the spoon, or by changing the spoon angle. Again, great care should be exercised since uniformity of coverage can be adversely affected by improper spoon beat or action. Here again the irrigation equipment dealer should be consulted. The farmer should insist on sprinklers that turn at an adequate speed and are so constructed as to maintain their speed of rotation. For the usual agricultural sprinklers with nozzle sizes up to 7/32" or gallonage up to 12 gph, with wetting diameters up to 10', the sprinkler should make a revolution at least every 60 seconds. The sprinkler should turn smoothly and uniformly and all the sprinklers on a line should rotate in approximately the same manner. The smaller sprinklers should turn in less time and larger sprinklers of course will take more time to complete a revolution.

The rate of precipitation is still another factor in creating conditions that may result in similar crop damage. Proper rate of application rotation is 5 mph or 7' per second, or a good fast walk to keep up with the moving stream of water near the outer periphery of the sprinkler throw.

A guide to adequate speed of the rate of precipitation is still another factor in creating conditions that may result in similar crop damage. Proper rate of application will maintain the soil's ability to continue to take water. Certainly the application rate should not exceed the slowest infiltration and percolation rate of the soil. On many soils this calls for application rates of 0.2" or even less. Proper system design and adequate equipment to meet the ever increasing demands require engineering of high order and intelligent operation by the farmer operator.