Sprinkler Nozzle Options Offer Choices For Growers

Droplet size can impact uniformity, soil

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Farmers today have a wide range of sprinkler-nozzle combinations from which to choose. The primary consideration in sprinkler system design is to obtain high water application uniformity. Another important consideration is to control droplet sizes to minimize droplet impact on the soil, while minimizing spray drift and evaporation.

Droplet impact on bare soil dislodges soil particles, reduces surface roughness, and causes infiltration reducing surface seals to form. The result may be surface ponding, runoff and potential erosion, especially on steeper slopes.

In one study on a silt loam soil, increasing the droplet kinetic energy from 7 to 24 J/Liter (kinetic energy per unit volume of water applied—see table for comparison values) decreased the water infiltration rate after 30 minutes by about 50 percent.

Studies on silt loam soils have shown that doubling droplet kinetic energy increased soil splash by a factor of three.

Recent advances in instrumentation allow us to obtain accurate droplet size distribution measurements from various types of sprinklers with different nozzle sizes and operating pressures. This equipment uses a laser-optical principle to measure drop sizes as they fall at various distances from the sprinkler.

The equipment measures drops as small as 0.2 mm in diameter. A computer model uses these distributions to calculate the kinetic energy of the spray as it impacts the soil for different operating conditions.

The Center for Irrigation Technology, Fresno, CA, was recently contracted by the USDA-Agricultural Research Service to measure drop size distributions from a wide range of sprinkler types commonly used on stationary laterals and center pivot irrigation systems in Idaho.

The main sprinkler type used on stationary laterals is the impact drive sprinkler with standard straight bore brass nozzles, flow control nozzles, or non-circular orifice nozzles which are used with lower pressures. Impact sprinklers are also used on center pivots, but low pressure spray heads are becoming more widely used and these offer good control of drop size ranges.

Various types of spray plates are available, ranging from flat plates which produce the smallest drops, to rotating grooved plates which produce larger drops while producing larger spray patterns.

For impact sprinklers, pressure level is the main factor affecting the drop sizes. However, for low pressure flat-plate spray heads, nozzle size is a more important factor controlling drop sizes.

A sample of the data is shown in the table. The table lists drop sizes and energy per unit volume of water applied for several pressure-nozzle combinations of five types of sprinklers or spray heads. The D50 value is the volumetric mean drop size in millimeters. The data is listed by increasing drop sizes and energy. The energy values are meaningful only by comparison.

Mean drop sizes, kinetic energy and pattern width for several types of sprinklers or spray heads.

Nozzle inch	Pressure psi	D50 mm	Energy J/Liter	Pattern diameter feet
Impact sprinkler, round nozzle				
5/32	72	1.4	13	[illegible]
9/64	58	1.4	14	[illegible]
7/32	80	1.4	14	[illegible]
1/8	40	2.4	21	[illegible]
5/32	30	3.0	25	[illegible]
1/8	20	4.2	[illegible]	[illegible]
Impact sprinkler, square nozzle				
9/64	30	1.8	18	[illegible]
5/32	40	1.8	18	[illegible]
5/32	20	2.4	21	[illegible]
11/64	30	2.6	22	80
Rotating plate spray head, 4 groove				
1/4	45	1.6	16	66
1/4	15	5.0	28	66
Rotating plate spray head, 6 groove				
3/16	30	1.4	14	58
3/8	30	1.6	16	57
1/4	15	2.0	19	56
Flat smooth plate spray head				
1/8	30	0.8	5	30
3/16	30	1.0	8	43
1/4	30	1.2	11	46
1/4	10	1.2	12	33
3/8	30	1.6	15	46
3/8	10	1.8	18	36

The impact sprinklers with round nozzles generally produce the highest droplet energy and the flat plate sprays the lowest energy, with the grooved plate spray heads in between. Energy values less than 15 are relatively low.