CONCEPTS OF SPRINKLER IRRIGATION: TYPES, DESIGN, ASSESSMENT, IMPLEMENTATION AND OPERATION

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CONCEPT AND FUNDAMENTAL ASPECTS

Sprinkler irrigation is the artificial rain that is produced by spraying the water that discharges from pressurized pipes. The water is sprayed into the atmosphere through emitters that can consist of drain nozzles arranged in a sprinkler mechanism that constitutes the last element of the distribution system.

- The distribution of water on the soil surface must be uniform.
- There should be no structural damage, neither by impact of the drops nor by ponding.
- Each drop must infiltrate where it falls in the soil so that there is neither runoff nor erosion.
- After water exits the nozzle, the jet is affected by climate conditions (wind and evaporation)

CONCEPT AND FUNDAMENTAL ASPECTS

- Hand move portable sprinklers. Lateral lines are moved once or twice a day.
- Portable Solid set. Lateral lines may be left in place during the irrigation system.
- Permanent systems. Normally uses buried main and lateral lines.
- Movable pipe structures. Center pivots, rangers, irrigation booms.

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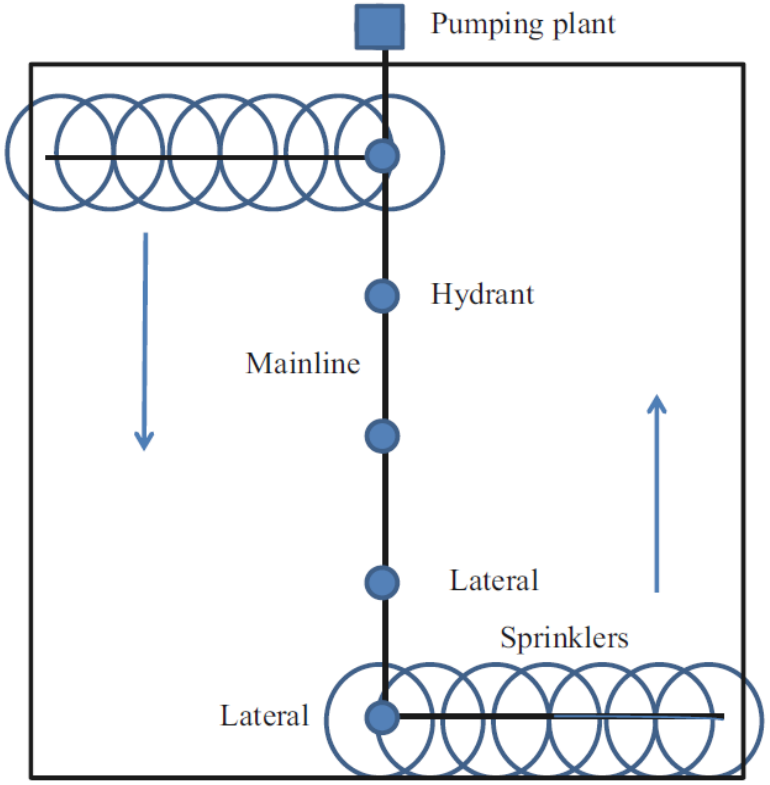

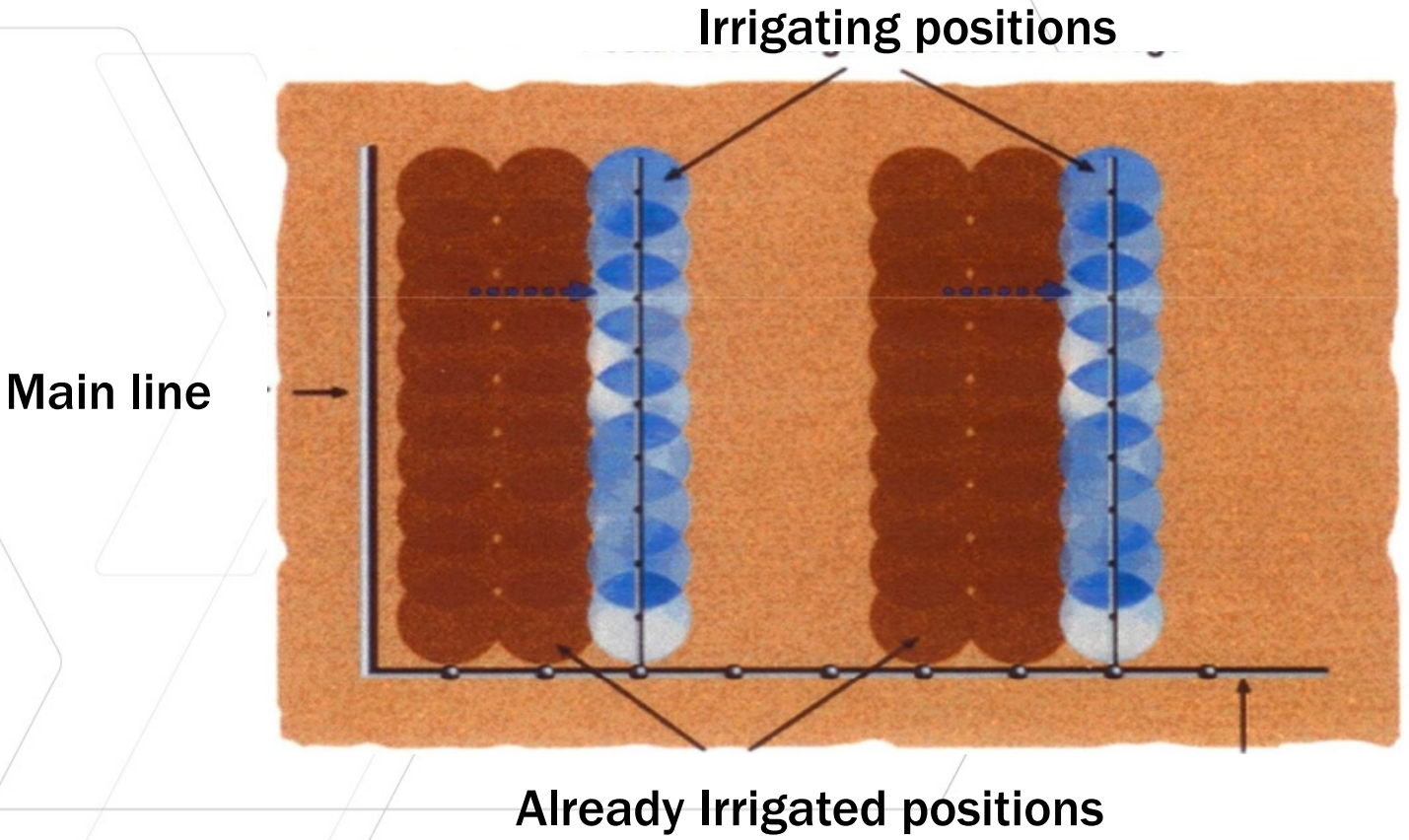

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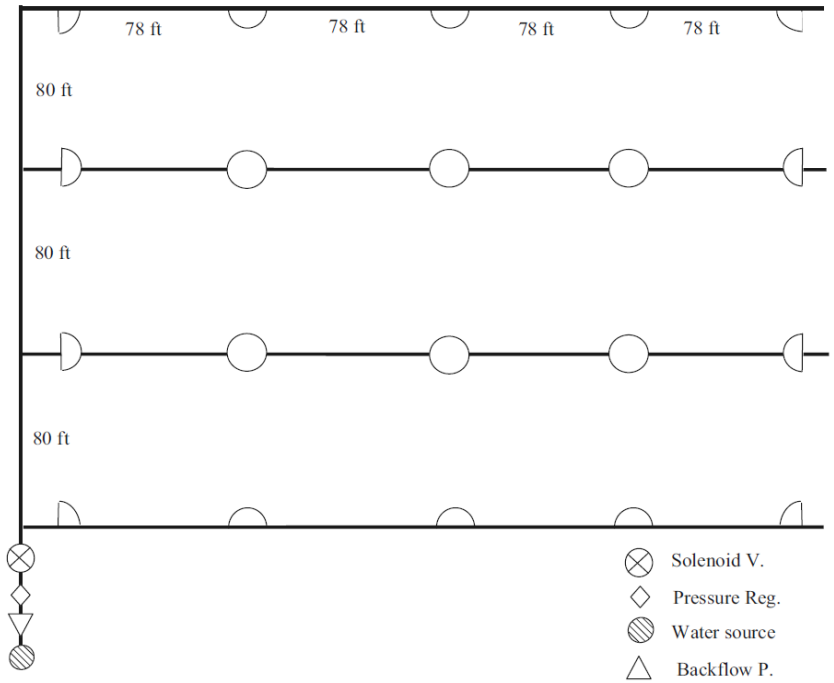

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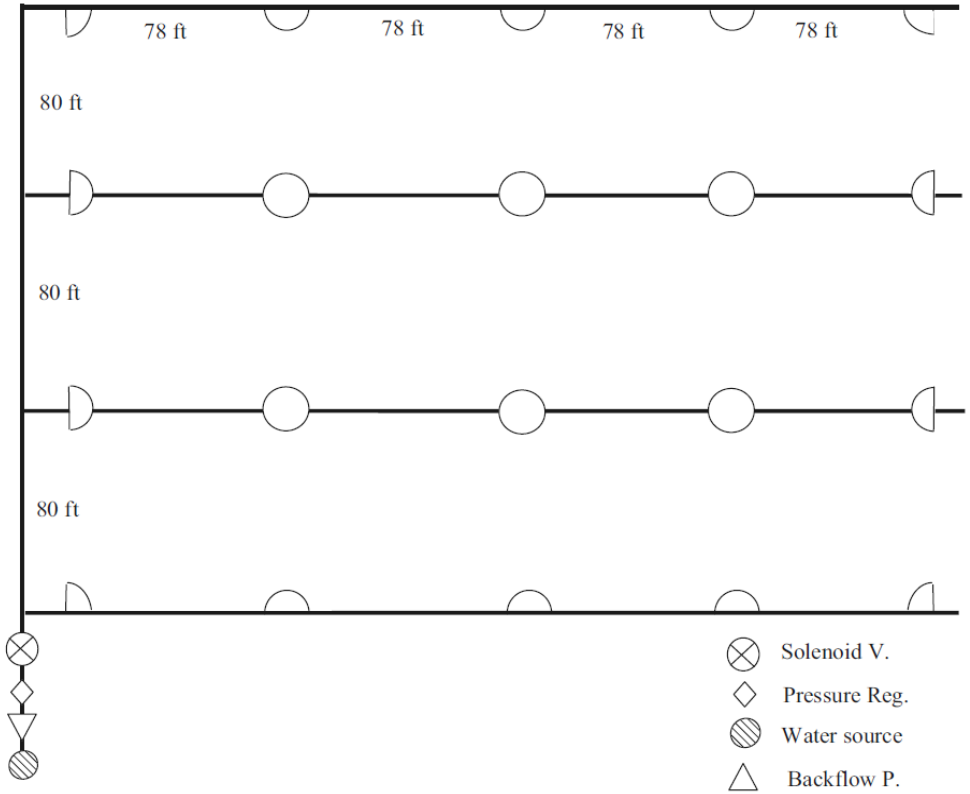


CONCEPT AND FUNDAMENTAL ASPECTS

- Movable pipe structures. Center pivots, rangers, irrigation booms.

IMPACT SPRINKLERS

- Impact sprinklers are the most common
- They use one or two nozzles with orifice diameters between 1/16 "and 9/16" (1.5 and 15 mm)
- Flow between 250 and 2400 L / h
- Pressure normally in the range 1.5 - 3 bar
- The jets are generally launched on the foliage of the crops (sprinkler tubes> 2 m)
- The angle of the outlet jet around 30º
- The effective wet diameter from 10 to more than 60 m
- The CU achieved is greater than 85%
- Average separation 9 to 18 m
- Sprinkler body: Plastic (lower price) and metallic (bronze and more durable)

OTHER SPRINKLER SYSTEMS

- Spray sprinkler

Flow 0.05 m^3/h

Pressure les than 2 bar

- Rain gun

Flow 200 m^3/h

Pressure 6-8 bar

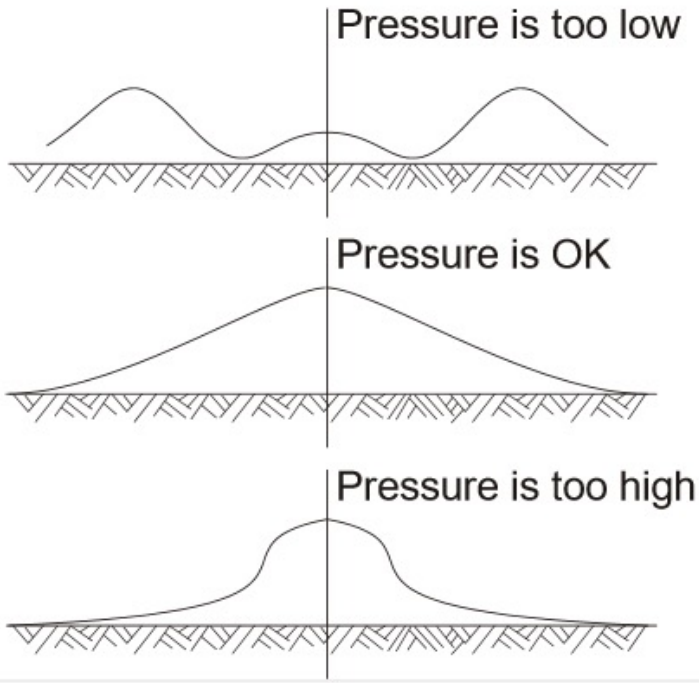
- Rotator sprinkler

Flow 0.1 - 0.8 m^3/h

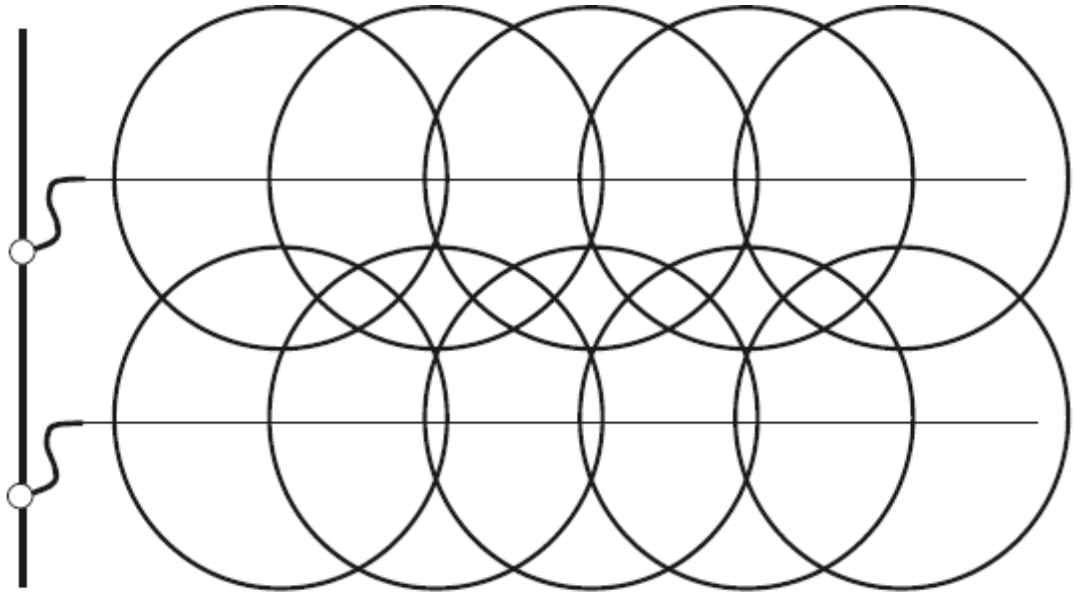
Pressure 1 – 2.75 bar

IMPACT SPRINKLERS

Relative effects of different pressures on precipitation profiles for a typical double nozzle sprinkler.



SPRINKLER SYSTEM LAYOUT



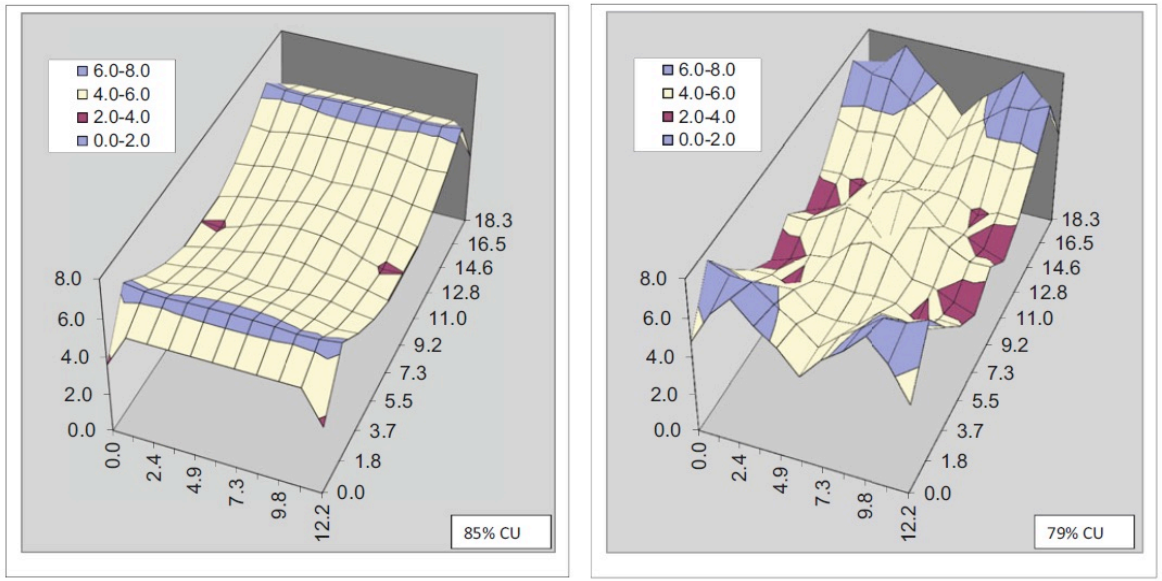


Fig. 14.6 Uniformities for 5/32″ nozzle on 40 ft × 60 f. spacing (12.2 × 18.3) with perfect wedge shape application pattern (*left*) and typical application pattern (*right*)

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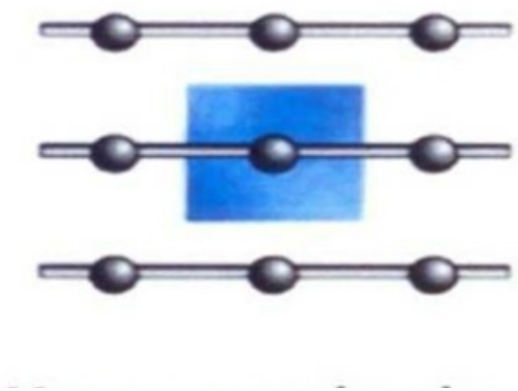
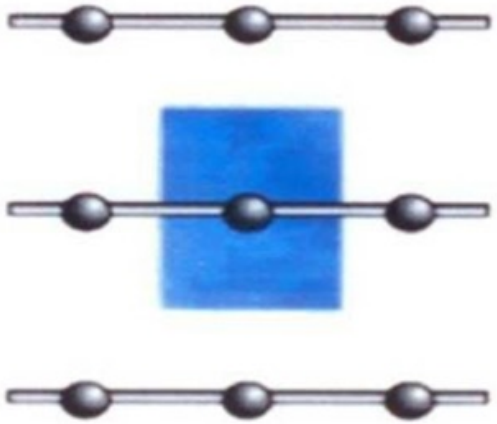
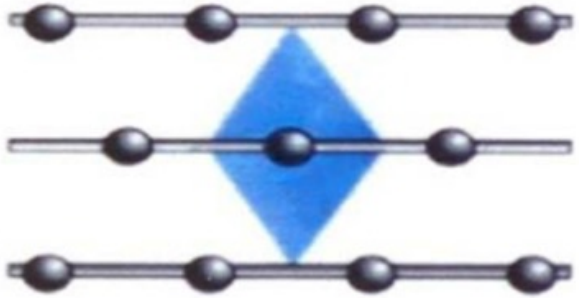


- Square



- Rectangular



- Triangular

El aspersor D-Net® 8550 es el nuevo aspersor de impacto de Regaber® especialmente diseñado para el riego de hortícolas y viveros.

VENTAJAS

- Alta uniformidad de distribución: máximo nivel de eficiencia en el uso del agua gracias a su brazo diseñado para conseguir una uniformidad más alta.
- Fabricado en materiales plásticos resistentes a la corrosión, a los productos químicos usados en agricultura y a los rayos UV.
- Se puede instalar en soporte metálico (cañas).
- Se complementa con una gama de soportes, piezas de conexión y tuberías en materiales plásticos.
- Disponibles los modelos sectoriales D-NET® 9575 AA con arco ajustable y caudales de 850 y 1.030 l/h.

ESPECIFICACIONES TÉCNICAS

- 7 caudales disponibles: 510, 580, 680, 810, 940,1135 y 1275 l/h.
- Caudal nominal a 2,5 bar de presión.
- Presión de trabajo recomendada: desde 2 bar a 3 bar, en el aspersor.
- Trayectoria del agua: 24 grados.
- Conexión rosca macho 1/2"
- Boquillas codificadas por colores para facilitar su identificación:

TAMAÑO BOQUILLA	COLOR	CAUDAL (l/h) *
2,3 +1,8	Gris +Verde lima	510
2,5 +1,8	Violeta +Verde lima	580
2,9 + 1,8	Naranja +Verde lima	680
3,2 + 1,8	Verde +Verde lima	810
3,5 + 1,8	Azul +Verde lima	940
3,5 + 2,5	Azul + Amarillo	1135
4,0 + 2,5	Negro + Amarillo	1275

* Caudal nominal a una presión de trabajo de 2,5 bar.

ACCESORIOS

Base Megastand

Alargador Megastand ½" Longitud 40 cm Rosca macho ½" – Rosca hembra ½"

Brazo Megastand

Kit aspersión ½" rosca hembra Tubo 120 cm Conector para PE

Kit aspersión ½" rosca hembra Tubo 120 cm Conector para PolyNet

RENDIMIENTO*

Tamaño boquilla (mm)	Color	Presión de trabajo (bar)	Caudal (l/h)	Diámetro mojado (m)	Precipitación (mm/h) Espaciado (m x m) 10 x 12	11 x 12	12 x 12	13 x 12
2,3 + 1,8	Gris + Verde lima	1,5	395	18	3,5	3,2	2,9	2,1
		2,0	456	18	3,5	3,2	2,9	2,7
		2,5	510	19	4,4	4,0	3,7	3,4
		3,0	559	19	4,8	4,4	4,0	3,7
2,5 +1,8	Violeta + Verde lima	1,5	449	18	3,7	3,4	3,1	2,9
		2,0	519	19	4,4	4,0	3,6	3,3
		2,5	580	19	4,9	4,4	4,0	3,7
		3,0	635	20	5,4	4,9	4,5	4,2
2,9 + 1,8	Naranja + Verde lima	1,5	527	18	4,4	4,0	3,7	3,4
		2,0	608	19	5,1	4,6	4,2	3,9
		2,5	680	20	5,7	5,1	4,7	4,3
		3,0	745	20	6,2	5,6	5,2	4,8
3,2 + 1,8	Verde + Verde lima	1,5	627	18	5,2	4,8	4,4	4,0
		2,0	724	19	6,1	5,5	5,0	4,7
		2,5	810	21	6,8	6,1	5,6	5,2
		3,0	887	21	7,4	6,7	6,2	5,7
3,5 + 1,8	Azul + Verde lima	1,5	728	18	6,0	5,5	5,0	4,6
		2,0	841	19	7,0	6,4	5,8	5,4
		2,5	940	21	7,9	7,1	6,5	6,0
		3,0	1030	21	8,6	7,8	7,2	6,6

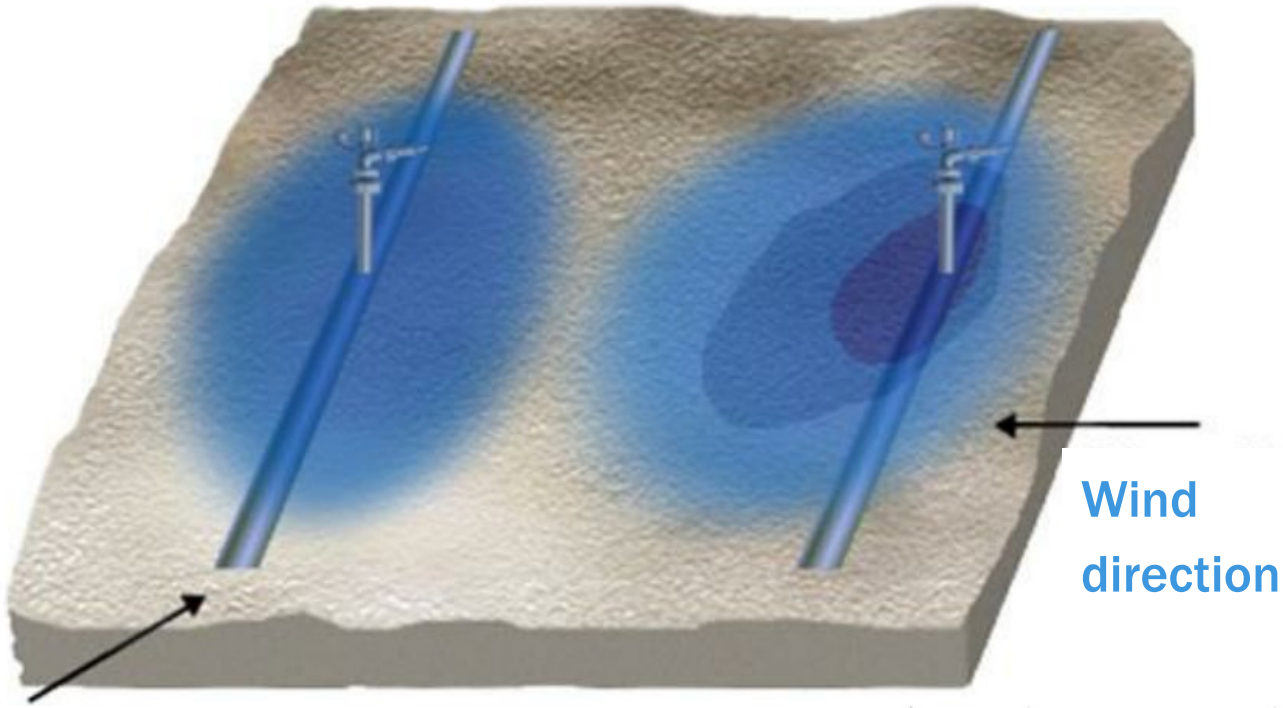
Tamaño boquilla (mm)	Color	Presión de trabajo (bar)	Caudal (l/h)	Diámetro mojado (m)	Precipitación (mm/h) Espaciado (m x m) 9 x 14	9 x 15	10 x 14	10 x 15
3,5 + 2,5	Azul + Amarillo	2,0	1015	22	8,1	7,5	7,3	6,8
		2,5	1135	22	9,0	8,4	8,1	7,6
		3,0	1243	22	9,9	9,2	8,9	8,3
4,0 + 2,5	Negro + Amarillo	2,0	1145	22	9,1	8,5	8,2	7,6
		2,5	1275	22	10,1	9,4	9,1	8,5
		3,0	1397	22	11,1	10,3	10,0	9,3

*En condiciones de laboratorio, altura del aspersor 1 m

CU = > 92%	CU = > 88% y < 92%	CU = > 86% y < 88%	CU < 86%

$$CU = 100\left[1 - \frac{\sum|H_i - H_{med}|}{nH_{med}}\right]$$

WIND EFFECTS



- When there are high speed winds, lateralts must be perpendicular to the wind direction.
- Triangular layout is more efficient in windy conditions.
- In windy conditions, lateralts should be installed closer.

EVAPORATION FROM THE JET

- Evaporation losses typically range between 10 and 20 % depending on the climate.
- Losses are higher in the case of fine droplets than in coarse droplets

LATERALS DESIGN

- The difference of pressure in the lateral

$$H_o = H_L + hf_L + \Delta Z_L$$

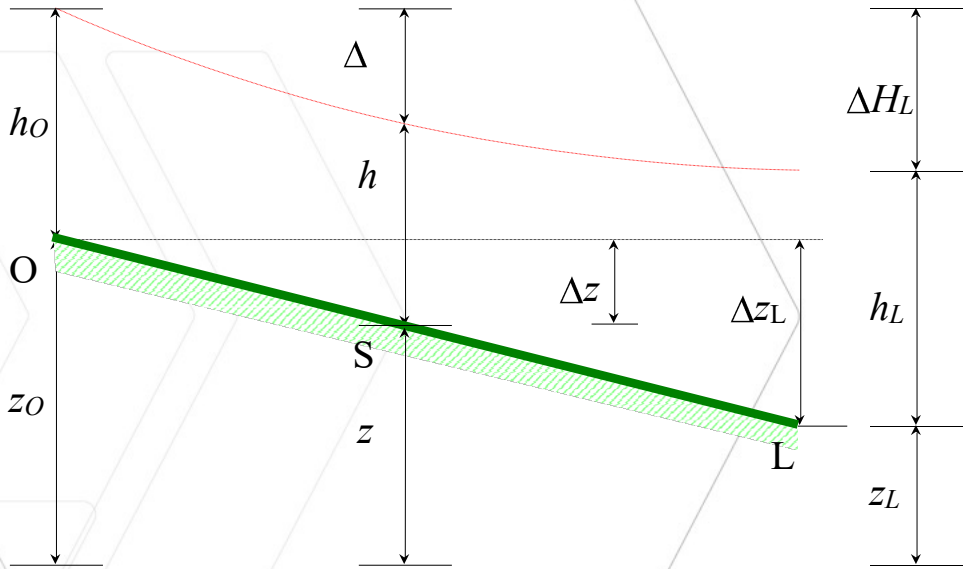
Where

H_o is the pressure at the begining

H_L is the pressure in the last emitter

hf_L represents the energy friction losses in the lateral

ΔZ_L is the difference in elevation



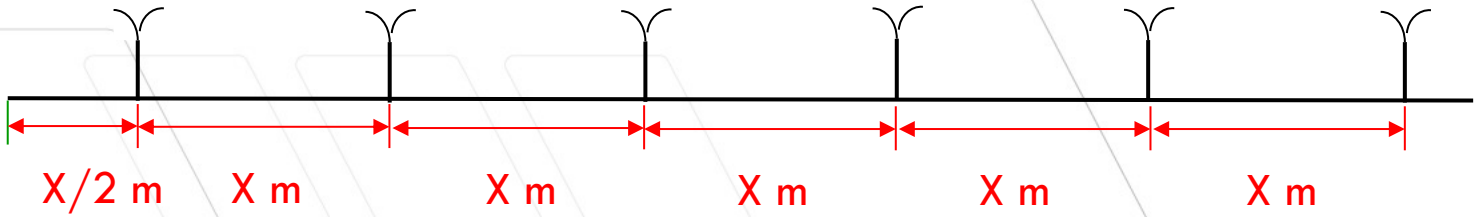
- **Discharge from a sprinkler**

$$q = k \cdot h^{0.5}$$

LATERALS DESIGN

- *Energy friction losses in the lateral*

$$hf_L = hf \cdot F$$



Where

hf are the friction losses in a fully flowing pipe

F is the Christiansen's friction factor

$$F = \frac{1}{m+1} + \frac{1}{2 \cdot N} + \frac{(m-1)^{0.5}}{6 \cdot N^2}$$

being N the number of emitters and m the exponent of the friction losses equation (2 in case of Darcy – Weisbach)

- *Increment of pressure in the lateral should be less than 20% of the emitter´s nominal pressure.* $\Delta h \leq 20\% \cdot h_n$