COOL FOG

Smart Cooling for Smart Farm

Air-Assisted Two-Fluid Atomization Nozzle

15.8 μm

Avg. Droplet Size — Laser Diffraction Analysis

- Temperature & Humidity Automation
- 4–12 °C Effective Cooling
- Patent No. 10-20240153539

WOOYEONG

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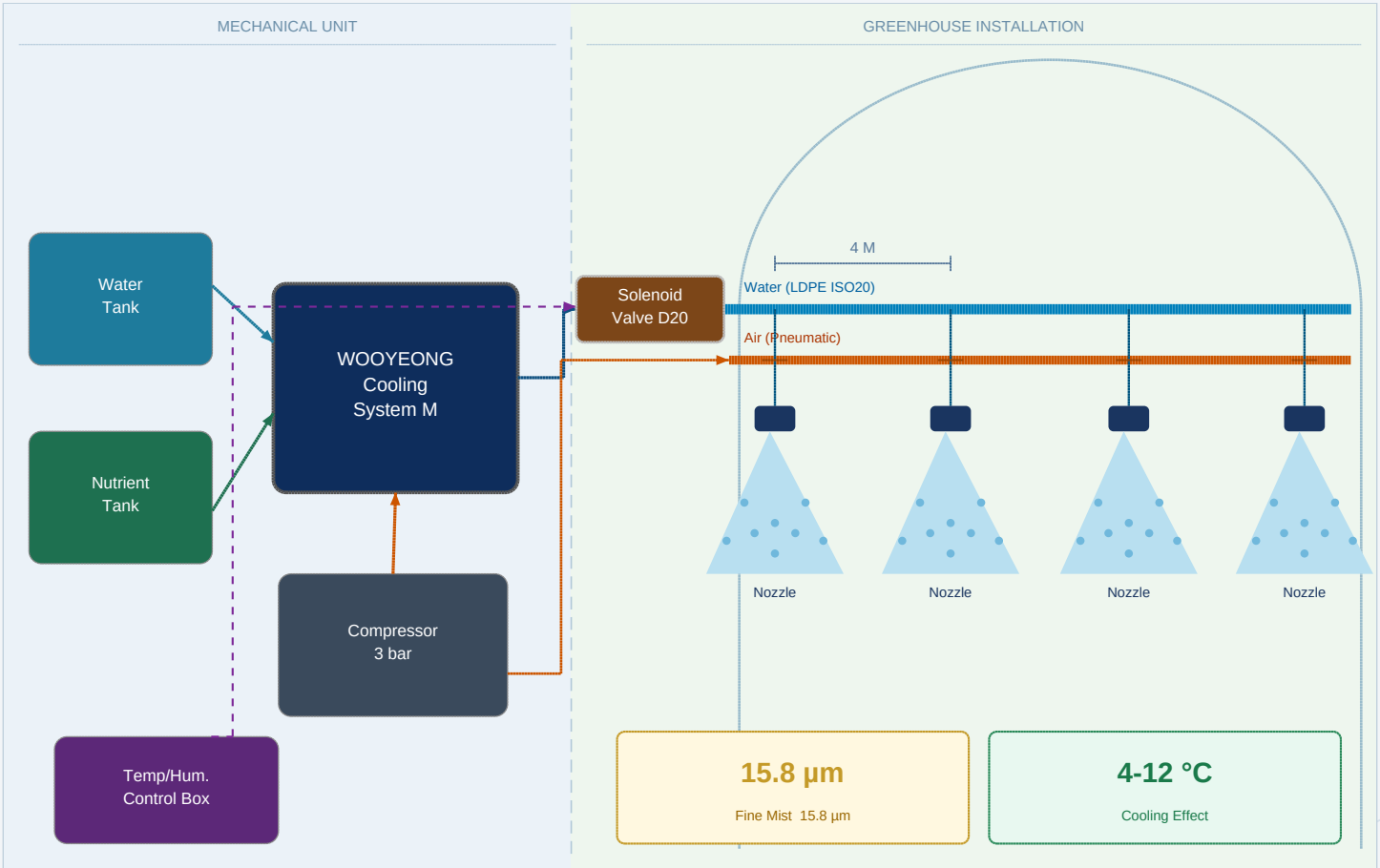
System at a Glance

Cool-Fog is a patented air-assisted two-fluid atomization system that delivers ultra-fine mist for precision temperature and humidity control in agricultural and industrial environments.

15.8 μm Avg. Droplet Size	**4–12 °C** Cooling Effect	**2 / 3 L/h** Flow Rates
3 bar Air Pressure	**3.5–5 bar** Spray Pressure	**8 M** Max. Range



- Researched & validated by Kyungpook National University Combustion Engineering Lab
- Patent-protected two-fluid atomization mechanism (Patent No. 10-20240153539)
- Compatible with nutrient solution injection for fertigation cooling
- IoT-ready: temperature & humidity controller with solenoid valve automation

Application Fields

Greenhouse / Facility Cultivation

Provides precise cooling and humidity maintenance for crops during high-temperature periods. Reduces heat stress, improves fruit setting rates, and enhances overall crop quality. Nozzles installed at 4M × 4M grid spacing ensure uniform coverage across the entire growing area.

- Reduce heat stress on crops
- Uniform coverage with 4M×4M grid
- Compatible with nutrient injection

Aerial Spray Treatment

Ultra-fine 10–30 µm droplets remain airborne for extended periods, maximizing contact with target surfaces. Ideal for pesticide and liquid fertilizer application with minimal waste and drift. The fine mist penetrates dense canopies effectively.

- 10–30 µm droplets stay airborne longer
- Minimal chemical waste & drift
- Penetrates dense crop canopy

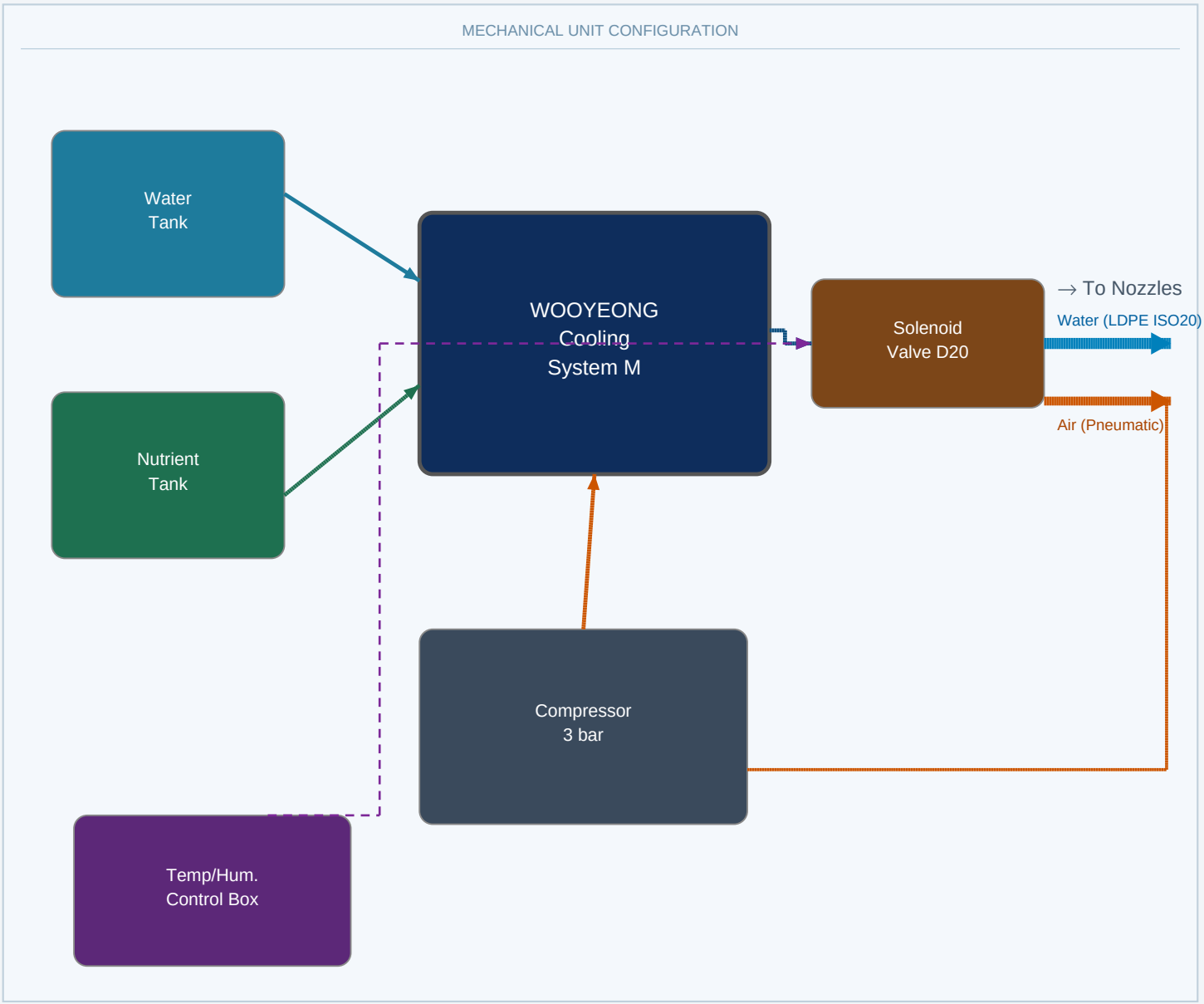
Livestock & Industrial Cooling

Significantly reduces heat stress in livestock buildings, improving feed conversion ratios and animal welfare. Also applicable for industrial dust suppression, humidification of storage facilities, and outdoor misting installations.

- Improves feed conversion ratio
- Reduces mortality from heat stress
- Dust suppression & humidification

10–30 µm	Extended	4M × 4M Grid	4–12 °C Drop
Droplet Size	Airborne Time	Coverage	Cooling

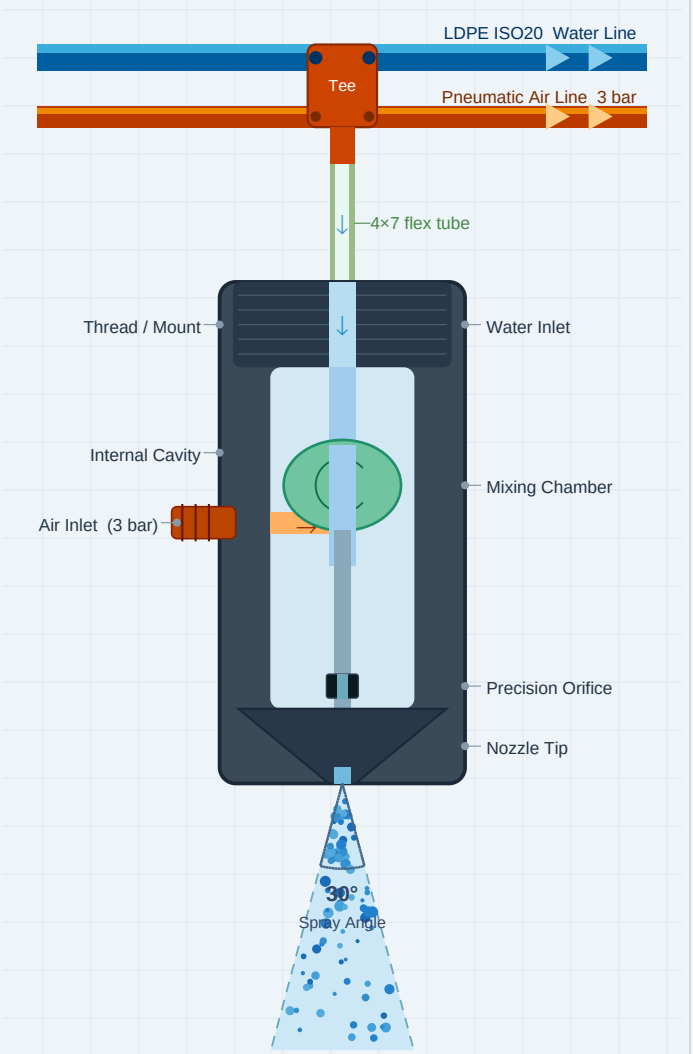
Mechanical System Configuration



#	Component	Description
①	Water Tank	Raw water supply with ball float valve and level indicator
②	Nutrient Tank	Solution tank with screen-type filter (D20mm) and stand
③	Cooling System M	WOOYEONG proprietary pump & mixing unit (motor-driven)
④	Air Compressor	Supplies pressurized air for two-fluid atomization (3 bar)
⑤	Temp & Humidity Control Box	IoT-ready controller managing solenoid valves automatically
⑥	Solenoid Valve D20	Automated water flow control (D20mm, electric-actuated)
⑦	LDPE Pipe ISO20	Main distribution pipe for water delivery to nozzle lines
⑧	Pneumatic Hose & Elbow	Air supply tubing from compressor to nozzle air-line

Core Technology & Patent

COOL-FOG NOZZLE WY-18101 | Cross-Section View
Internal Mixing — Patent No. 10-20240153539



Ultra-Fine Mist 10–30 μm Avg. Droplet
Rapid evaporation · instant cooling · zero runoff

1. Water & compressed air enter separate inlets
2. Two fluids meet at precision mixing chamber
3. High-velocity air shatters water into 10–30 μm droplets
4. Ultra-fine mist exits at controlled angle (~30°)
5. Droplets evaporate rapidly -> instant cooling effect

Two-Fluid Atomization
Air + Water dual fluid system produces ultra-fine mist impossible with single-fluid nozzles

Patent Protected
Unique internal mixing geometry (Patent No. 10-20240153539) ensures superior atomization

Dual Flow Rate
2 L/h for finer mist (smaller droplets), 3 L/h for longer spray reach

Low Water Usage
Micro-mist evaporates before reaching soil — zero runoff, minimal water waste

IoT Compatible
Integrates with smart farm sensors for automated temperature-triggered operation

Nutrient Compatible
Suitable for liquid fertilizer injection during cooling operation (fertigation)

[Patent] Korean Patent No. 10-20240153539
Patented two-fluid atomization nozzle design — protected intellectual property of WOOYEONG Agricultural Materials.

University Research Validation

Kyungpook National University — Combustion Engineering Research Lab

School of Mechanical Engineering, Kyungpook National University, Daegu, Korea

Research Scope

① Droplet size measurement (average diameter & size distribution by count)
② Maximum spray reach (distance from nozzle tip)
③ Spray angle measurement under varying pressure conditions
④ Airborne dwell time (5,000-droplet sampling at 500 mm from tip)
⑤ High-speed video imaging of spray plume (separate submission)

Key Research Findings

Droplet Size vs Air Pressure

As air pressure increases, average droplet size decreases — higher air momentum promotes finer atomization.

Droplet Size vs Spray Pressure

As spray pressure increases, average droplet size increases — higher liquid flow rate increases droplet volume.

2 L/h vs 3 L/h Nozzle

Under identical conditions, 2 L/h nozzle produces SMALLER droplets than 3 L/h due to nozzle design geometry.

Spray Distance

Spray reach increases with both air and water pressure. 3 L/h reaches FARTHER than 2 L/h under equal pressures.

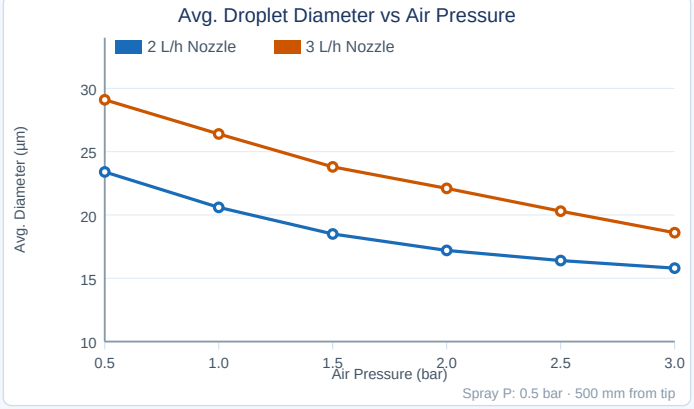
Spray Angle (~18°)

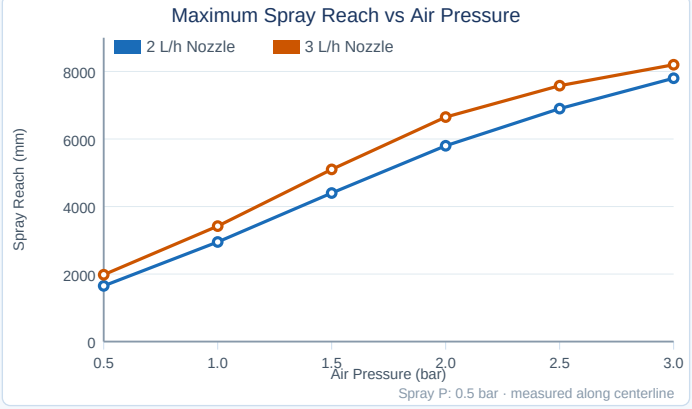
At 0.5 bar air: ~18°. Angle increases with air pressure, decreases with spray pressure. 3 L/h has wider angle.

Airborne Dwell Time

Dwell time decreases as pressure increases. Air pressure has GREATER effect than water pressure on dwell time.

Research Data · Kyungpook National University Combustion Engineering Lab · Laser Diffraction (Malvern Mastersizer)



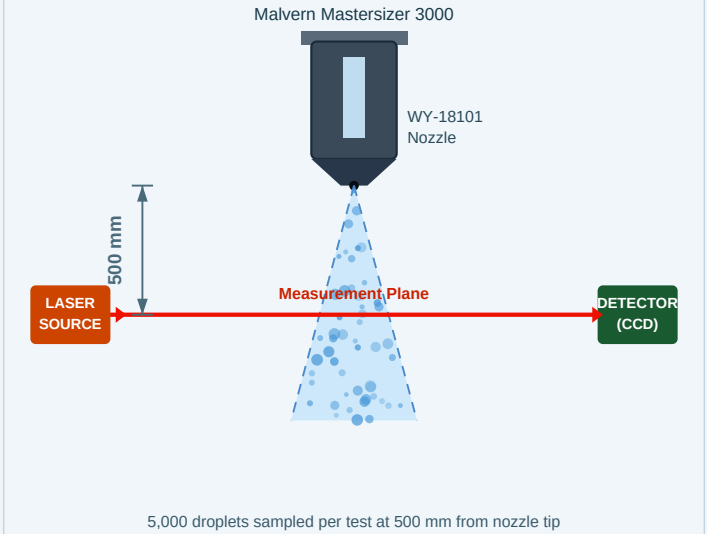


Particle Size Measurement — 2 L/h Nozzle

Measurement Method

Laser diffraction analysis (Malvern Mastersizer). Measures full particle size distribution at specified flow and pressure. 5,000 droplets sampled at 500 mm from nozzle tip.

Laser Diffraction Measurement Setup



5,000 droplets sampled per test at 500 mm from nozzle tip

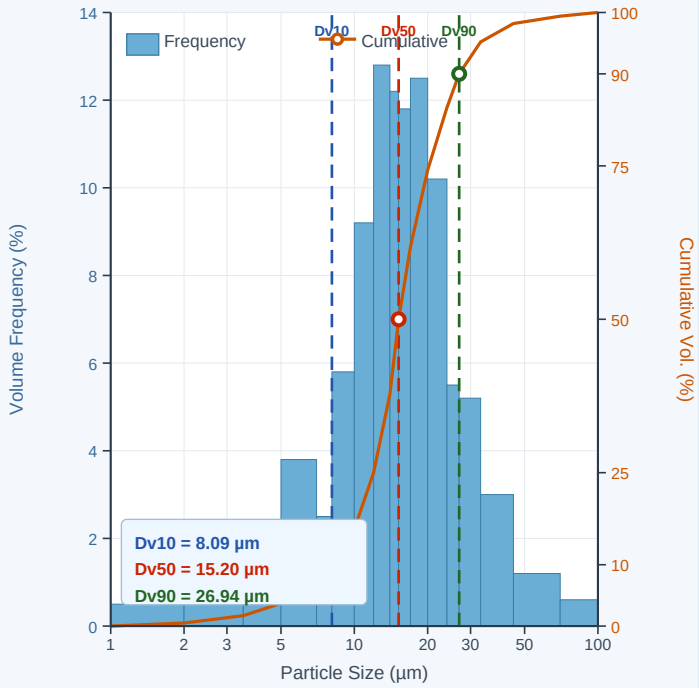
Test Conditions (2 L/h)

Air Pressure	**0.5 – 3 bar**
Spray Pressure	**3 – 5 bar**
Increment	**0.5 bar steps**
Nozzle	**2 L/h**

Measurement Results (2 L/h)

Particle Size Distribution — 2 L/h

Air: 2 bar | Spray: 2 L/h



D(v, 0.1) — 10th Percentile	**8.09 µm**
D(v, 0.5) / Dv50 — Median	**15.20 µm**
D(v, 0.9) — 90th Percentile	**26.94 µm**
Mean Diameter	**15.16 µm**
Mode Diameter	**12.46 µm**

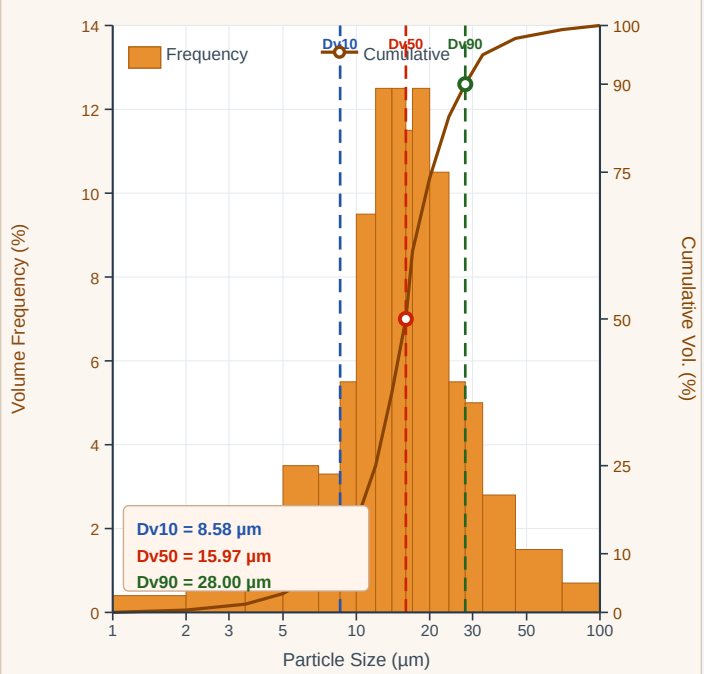
Dv50 = 15.20 µm — well within the 10–30 µm optimal cooling range.

Particle Size — 3 L/h Nozzle & Comparison

Results — 3 L/h Nozzle

Particle Size Distribution — 3 L/h

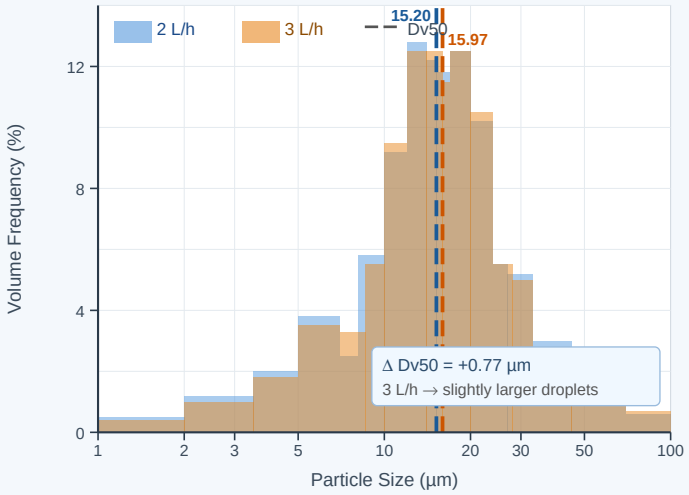
Air: 2 bar | Spray: 3 L/h



D(v, 0.1) — 10th Percentile	**8.58 µm**
D(v, 0.5) / Dv50 — Median	**15.97 µm**
D(v, 0.9) — 90th Percentile	**28.00 µm**
Mean Diameter	**16.12 µm**
Mode Diameter	**12.46 µm**

2 L/h vs 3 L/h Comparison

2 L/h vs 3 L/h — Overlay Comparison

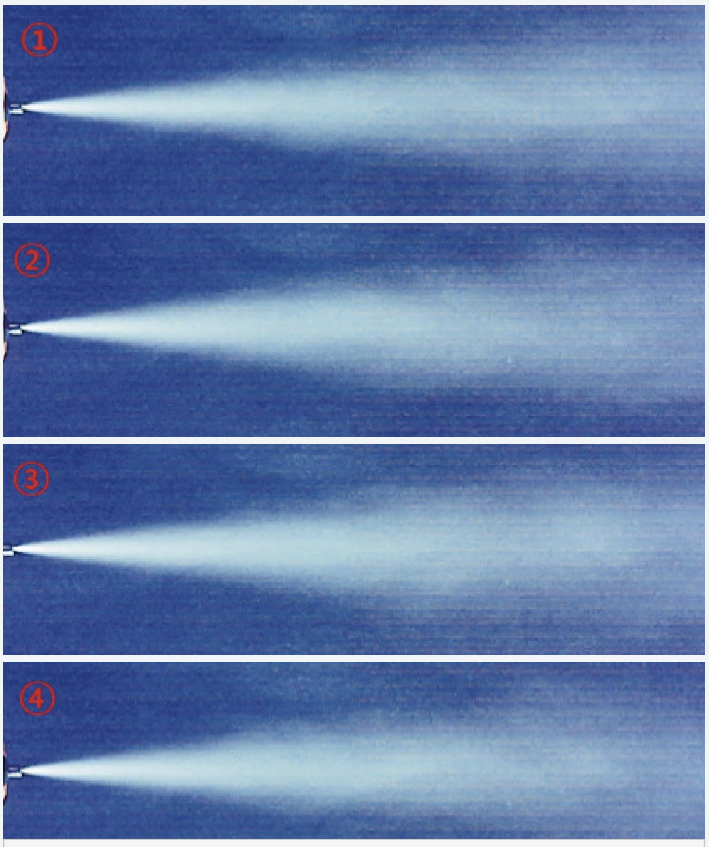


Parameter	2 L/h	3 L/h	Difference
Dv50 (Median)	15.20 µm	15.97 µm	+0.77 µm
D(v,0.1)	8.09 µm	8.58 µm	+0.49 µm
D(v,0.9)	26.94 µm	28.00 µm	+1.06 µm
Mean	15.16 µm	16.12 µm	+0.96 µm
Mode	12.46 µm	12.46 µm	= equal
Spray Reach	Shorter	Longer	3L/h farther
Spray Angle	Narrower	Wider	3L/h wider

Recommendation: Use 2 L/h for fine cooling & humidification. Use 3 L/h for larger spaces requiring longer spray reach.

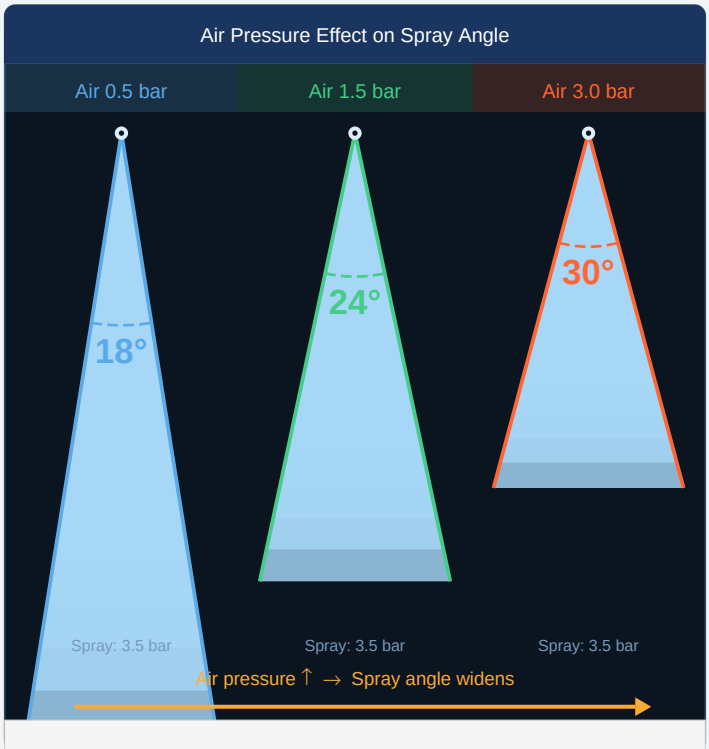
Spray Distance & Angle Analysis

Spray Distance



Air 0.5 bar + Spray 3–5 bar	**~300 mm (2 L/h)**
Air 1.5 bar + Spray 3–5 bar	**300+ mm (2 L/h)**
Air 3.0 bar + Spray 3.5–5 bar	**300+ mm (2 L/h)**
Real installation (field)	**Up to 8 M**
3 L/h vs 2 L/h	**3 L/h reaches farther**

Spray Angle

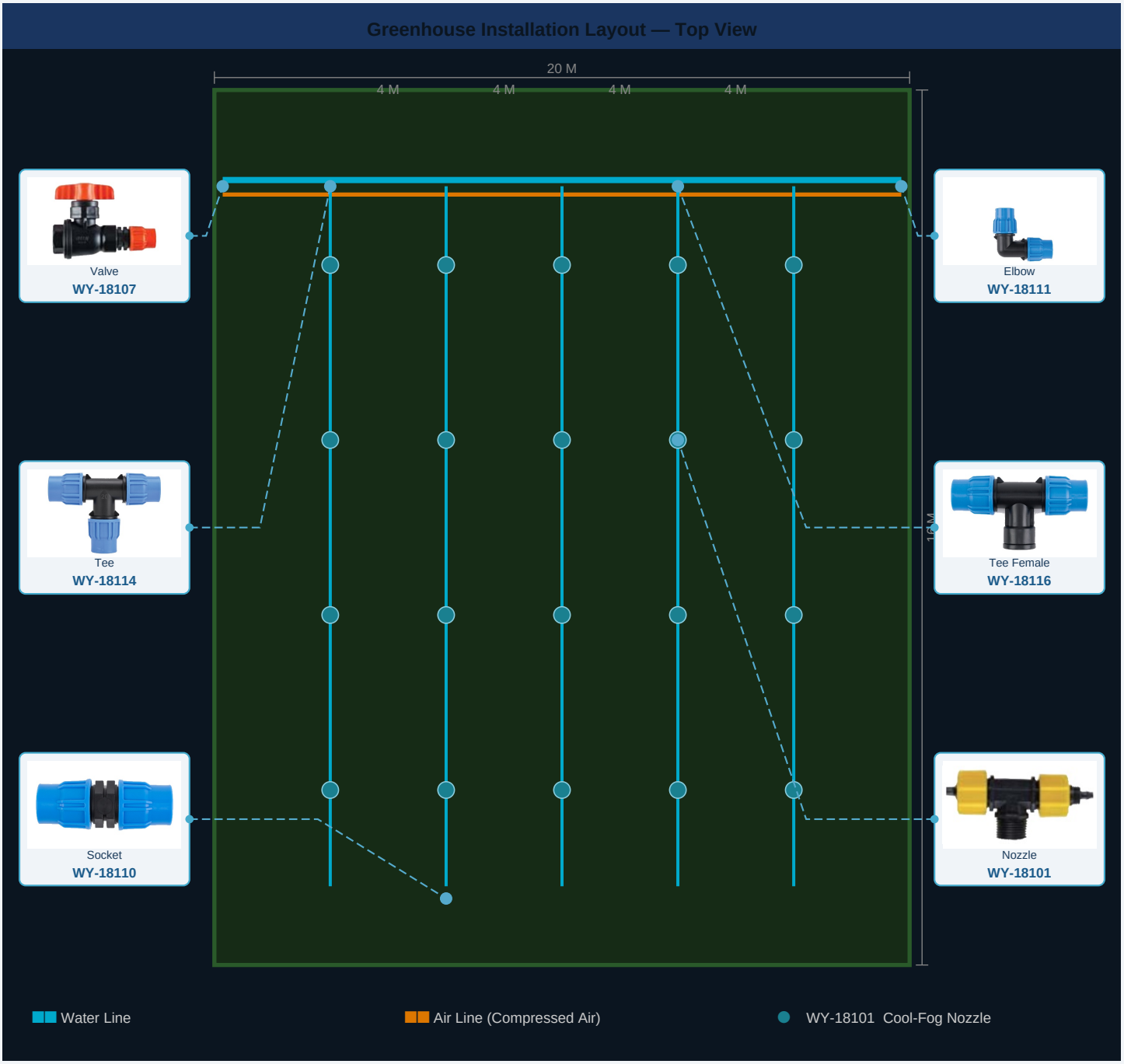


Air 0.5 bar (fixed)	**~18° spray angle**
Air pressure increase →	**Angle increases**
Spray pressure increase →	**Angle decreases**
2 L/h vs 3 L/h	**3 L/h has WIDER angle**
Optimal (Air 3 bar)	**~30° (field recommended)**

Note: Lab measurements limited to 300 mm (camera range). Field installations achieve up to 8 M horizontal reach.

Optimal Operating Condition	Recommended Spray Angle	Max Field Range
Air: 3 bar / Spray: 3.5–5 bar	**~30° (increases with air pressure)**	**8 M horizontal reach**

Installation Layout — Top View



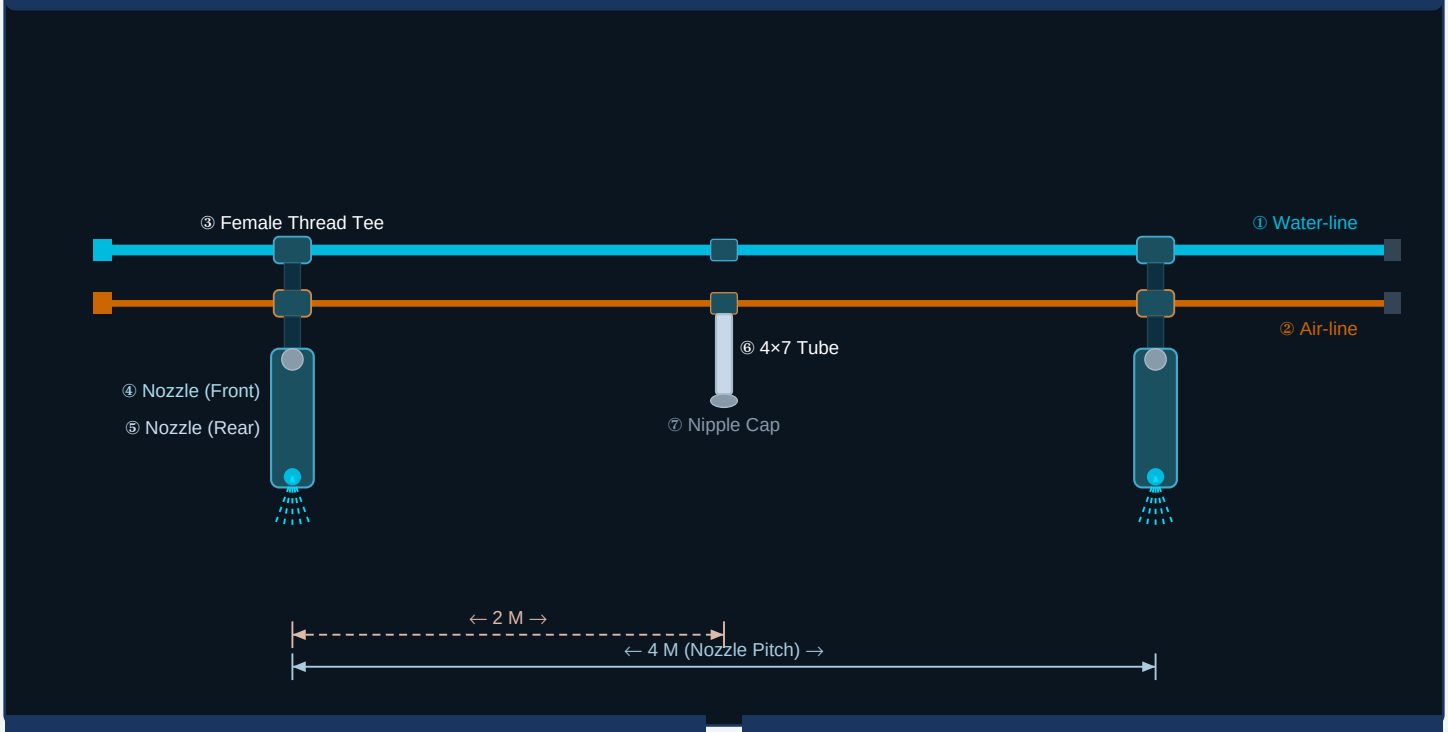
Layout Legend

- Water-line (Water supply pipe — cyan)
- Air-line (Compressed air pipe — orange)
- Cool-Fog Nozzle (4M × 4M grid spacing)
- Cool-Fog Valve
- Cool-Fog Female Thread Valve
- Mechanical Unit — corner installation

Nozzle Grid Spacing: 4M × 4M (row spacing 4M, nozzle pitch 4M). Sub-line spacing 2M for mounting alignment.

Installation Detail — Nozzle Assembly

Nozzle Line — Side Elevation



Assembly Components

❶ Water-line
Supply pipe (cyan) — carries pressurized water to nozzle

❷ Air-line
Supply pipe (orange/brown) — carries 3 bar compressed air

❸ Cool-Fog Female Thread Tee
Connects nozzle to both Water-line and Air-line simultaneously

❹ Cool-Fog Nozzle (Front)
Spray face — emits 30° cone micro-mist forward

❺ Cool-Fog Nozzle (Rear)
Drain/cap face — sealed with nipple cap when not in use

❻ 4×7 Tube (White)
Micro-tube for external connections and sub-branching

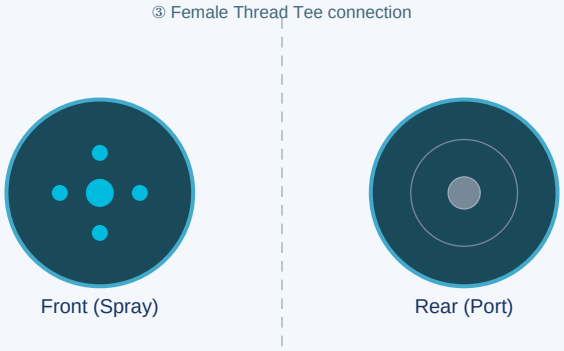
❼ Nipple Cap
Seals unused rear port of nozzle assembly

❽ Nozzle Pitch: 4M
Main spacing between nozzle assemblies along the line

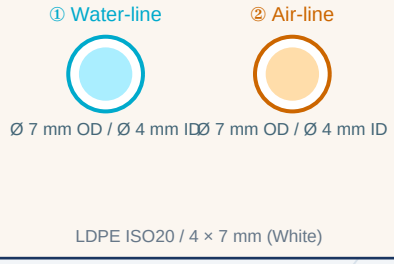
❾ Sub-Line Pitch: 2M
Mid-point support and branch connection at 2M intervals

Nozzle Cross-Section (Front / Rear)

Nozzle Cross-Section (Front / Rear)



Supply Pipe Cross-Section



Nozzle Pitch:	**4 M**
Sub-line Pitch:	**2 M**
Tube Size:	**4 × 7 mm (white)**
Pipe Std.:	**LDPE ISO20**

Installation Accessories

WY-18107
Ball Valve
Zone on/off flow control valve

WY-18109
Male Thread Nipple
Threaded connector for main supply line

WY-18110
Compression Socket
Straight-line pipe compression coupling

WY-18111
Compression Elbow 90°
90° direction change for pipe routing

WY-18112
Male Thread Elbow 90°
90° elbow with male-thread end connection

WY-18114
Compression Tee
3-way tee fitting for branch connections

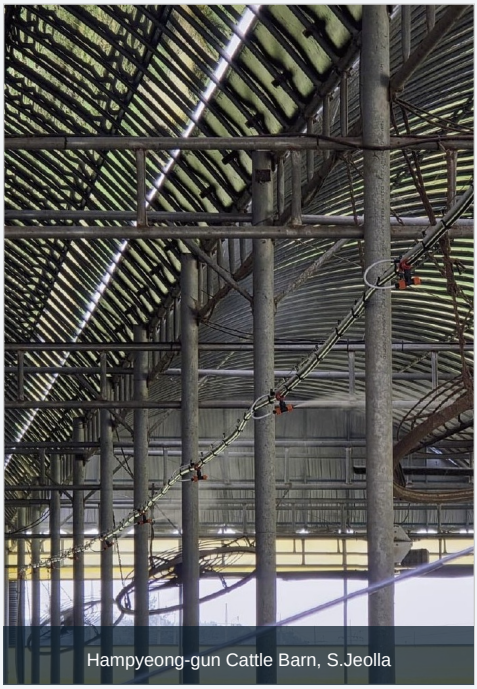
WY-18115
Male Thread Tee
3-way tee with male-thread branch port

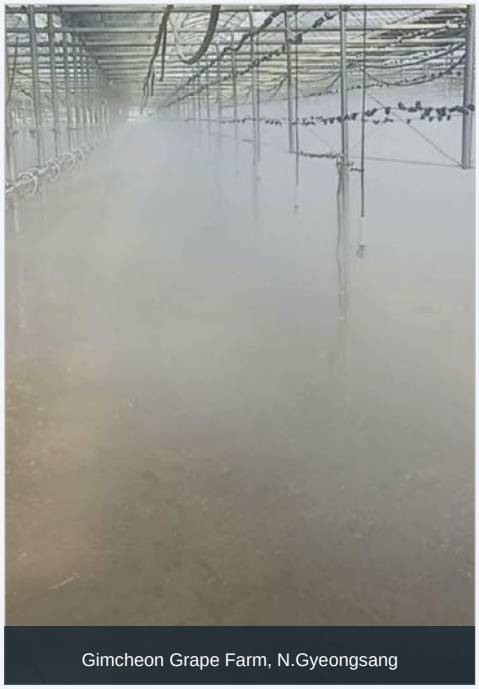
WY-18116
Female Thread Tee
3-way tee with female-thread branch port

* All accessories are designed for Cool-Fog micro-mist nozzle systems. Contact WOOYEONG for specifications and availability.

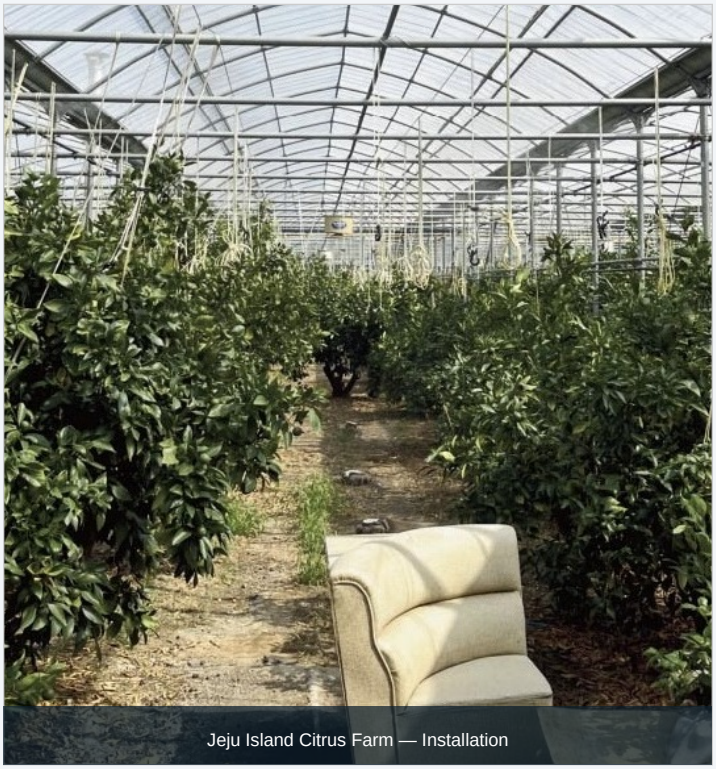
Installation Sites & References


Seongju Agr. Tech. Center, N.Gyeongsang


Hampyeong-gun Cattle Barn, S.Jeolla


Gimcheon Grape Farm, N.Gyeongsang


Jeju City Citrus Farm — Cooling System


Jeju Island Citrus Farm — Installation

5+	2	4–12 °C	15.8 μm
Installation Sites	Flow Rate Models	Cooling Effect	Avg. Droplet

COOL FOG

Smart Cooling for Smart Farm

15.8 μm	4–12 °C	8 M
Avg. Droplet	Cooling Effect	Max. Range

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