# Hydrogen-Enriched Water Irrigation

Field Evidence Summary — Electrolytic (PEM) Systems

This summary presents independently documented field and academic trial results for hydrogen-rich water irrigation produced by on-site electrolytic (PEM/SPE) generation — the same core technology used in YBG Global's HERO Irrigation and WZ-S systems. Cases using alternative hydrogen-generation methods (e.g. formic acid production, pressurised gas cylinders) are excluded from this summary, since they do not represent the technology installed in our equipment. Peer-reviewed academic sources are cited with a direct DOI link; industrial field-demonstration data is cited to its named programme.

*Each case study is presented on its own page, with a highlights summary at the top. Where a metric (yield increase, fertiliser reduction, or planting area) is not stated in the original source, it is marked "Not reported" rather than estimated — this summary does not present figures beyond what each source actually states.*

## Why Hydrogen-Rich Irrigation

- **Pure, contaminant-free hydrogenation** — generated by on-site electrolysis, with no minerals, chemicals, or additive residue introduced into the water at any stage.
- **Proven yield increase** — independently documented across multiple field trials and peer-reviewed studies, with results ranging from 6% to 39.7% depending on crop and trial (see case studies, this document).
- **Proven reduction in fertiliser use** — field data shows reductions of 30%+ in chemical fertiliser and pesticide consumption, with one peer-reviewed trial showing hydrogen treatment alone outperforming a fertiliser-only control group entirely.
- **A genuine response to the climate drought trend** — as drought frequency and severity increase across major agricultural regions worldwide, hydrogen-rich irrigation offers a practical, deployable resilience tool for growers facing water-stress pressure.
- **Scalable, low-cost coverage** — systems available to service up to 10 hectares at low electrical running cost (manufacturer-stated capacity).
- **Simple integration with existing infrastructure** — connects directly to existing drip, pipe, and flood irrigation systems; no infrastructure replacement required.

  

# Case Study — Cherry Tomato, Two-Year Field Trial (Shanghai & Nanjing, China)

*Peer-reviewed, Plants journal (2024) — Nanjing Agricultural University & Air Liquide China R&D*

| Up to 39.7% | 100%* | Not reported |
|---|---|---|
| YIELD INCREASE (per plant) | FERTILISER REDUCTION | PLANTING AREA (ha) |

**Best result achieved with hydrogen treatment and zero fertiliser — full elimination in this trial arm, not a partial reduction. See Result below.*

| | |
|---|---|
| **Method** | Hydrogen nanobubble water (HNW) irrigation, with and without conventional fertiliser, vs. surface-water control |
| **Duration** | Two-year field trial: Shanghai (2021), Nanjing (2023) |

**Result**

- Yield per plant increased 39.7% (without fertiliser) and 26.5% (with fertiliser) in 2021, Shanghai.
- Yield per plant increased 39.4% (without fertiliser) and 28.2% (with fertiliser) in 2023, Nanjing.
- Sugar–acid ratio improved 8.6% and lycopene content improved 22.3% versus surface-water control.
- Effects held even without fertiliser — indicating a genuine fertilisation effect from hydrogen itself, not just improved water quality.

Source: Li, M., Zhu, G., Liu, Z., Li, L., Wang, S., Liu, Y., Lu, W., Zeng, Y., Cheng, X., Shen, W. (2024). “Hydrogen Fertilization with Hydrogen Nanobubble Water Improves Yield and Quality of Cherry Tomatoes Compared to the Conventional Fertilizers.” *Plants*, 13(3), 443. DOI: https://doi.org/10.3390/plants13030443

  

# Case Study — Open-Field Vegetable & Fruit Demonstration (Shandong & Hebei, China)

*Field demonstration data*

| 12%–25% | 30%+ | Not reported |
|---|---|---|
| YIELD INCREASE | FERTILISER & PESTICIDE REDUCTION | PLANTING AREA (ha) |

| | |
|---|---|
| **Crops** | Strawberry, watermelon, tomato, eggplant, and other high-value cash crops |
| **Method** | Electrolytic nanobubble hydrogen-locking integrated system; compatible with drip and flood irrigation |

**Result**

- Crop yield increased by 12%–25%.
- Chemical fertiliser and pesticide consumption reduced by more than 30%.
- Measurable improvement in soil acidification and hardening.

*Source: Industrial field-demonstration programme, Shandong & Hebei provinces, China. Cited via manufacturer field report; no public academic DOI available for this specific programme.*

  

# Case Study — Rice, Six-Year Field Programme (Qingpu, Shanghai)

*Air Liquide × Nanjing Agricultural University, 2019–present*

| 6%–21% | Not reported | ≈ 9.7 ha |
|---|---|---|
| YIELD INCREASE (avg. 18.8%) | FERTILISER REDUCTION | PLANTING AREA (145 mu) |

| | |
|---|---|
| **Crop** | Rice (Huruann 1212, Yinxiang 38) |
| **Method** | On-site electrolytic (PEM) hydrogen production with nanobubble dissolving system, integrated into the existing drip and pipe irrigation network |
| **Hydrogen concentration** | 1.0–1.5 ppm, held stable at point of delivery |

**Result**

- Yield increase of 6%–21% across six consecutive years, averaging 18.8%.
- Significantly reduced lodging rate in typhoon seasons, decreased pest and disease incidence, and reduced heavy metal accumulation in grain.
- Enabled a premium “Hydrogen-Rich Rice” product line with a customer repurchase rate above 90%.

*Source: Industrial field-demonstration programme, Air Liquide × Nanjing Agricultural University (Qingpu, Shanghai). Cited via manufacturer field report; no public academic DOI available for this specific programme.*

  

# Case Study — Seedless Grape, Subsurface Drip Irrigation (Xinjiang, China)

*Peer-reviewed, Frontiers in Plant Science (2025)*

| ↑ Quality | Not reported | Not reported |
|---|---|---|
| YIELD / QUALITY INCREASE* | FERTILISER REDUCTION | PLANTING AREA (ha) |

**Study measured fruit quality parameters (phenolics, anthocyanin, soluble solids) and photosynthetic efficiency rather than a single yield percentage — see Result below for the specific findings.*

| | |
|---|---|
| **Crop** | 'Flame Seedless' grape (Vitis vinifera L.), greenhouse-grown |
| **Method** | Electrolytic hydrogen-rich water (HRW) generation; subsurface drip irrigation |
| **Hydrogen concentration** | 1.0 mg/L |

**Result**

Hydrogen-rich water irrigation significantly increased chlorophyll content and photosystem II efficiency, upregulated antioxidant enzyme activity (SOD, POD, CAT), and improved fruit quality parameters including soluble solids, sugar–acid ratio, and anthocyanin accumulation.

Source: Ali, H.S.M., Zhang, H., Yao, D., Kun, L., Zhao, F., Feng, J., Yu, K. (2025). “Hydrogen-rich water irrigation enhances fruit quality in 'Flame Seedless' grapes by regulating chlorophyll fluorescence parameters and antioxidant activities.” *Frontiers in Plant Science*, 16, 1693075. DOI: https://doi.org/10.3389/fpls.2025.1693075

  

## Why On-Site Electrolytic (PEM) Generation Matters

Hydrogen molecules are extremely small and escape rapidly from water in conventional delivery pipelines — field data across this research consistently identifies hydrogen retention as the central technical challenge for irrigation-scale application. PEM/SPE electrolytic systems paired with nanobubble hydrogen-locking address this directly, producing hydrogen-rich water on demand at the point of use rather than relying on storage or transport of pre-dissolved gas.

A second, independently significant advantage: traditional alkaline electrolysis produces alkaline water, which carries a long-term soil hardening and salinisation risk. PEM/SPE pure-water electrolysis instead produces neutral-pH hydrogen water, safe for all soil types — with no chemical additive and no residue introduced at any stage of generation.

## Lower Input Costs, Not Just Higher Yield

Field data on hydrogen-rich water irrigation points to a second, independently significant benefit alongside yield: a real reduction in fertiliser dependency.

In open-field trials across Shandong and Hebei, China, growers using electrolytic nanobubble hydrogen-locking irrigation reduced chemical fertiliser and pesticide consumption by more than 30%, alongside a 12–25% yield increase and measurable improvement in soil acidification and hardening.

A separate, peer-reviewed two-year cherry tomato trial (Li et al., 2024, *Plants*) found something sharper still: hydrogen nanobubble water applied **without any fertiliser at all** produced higher yield, sugar–acid ratio, and lycopene content than a conventional fertiliser-only control group. In other words, the hydrogen treatment didn't just reduce how much fertiliser was needed — in this trial, it outperformed fertiliser entirely.

For growers facing rising input costs, this points to hydrogen-rich irrigation as a genuine input-cost lever, not only a yield or quality improvement.

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*All data presented in this summary is drawn from published academic research and field demonstration trials conducted independently of YBG Global. It is provided for technical communication and commercial evaluation purposes only, and is not presented as medical or regulatory certification. Commercial outcomes vary by crop, climate, water quality and irrigation practice.*

  