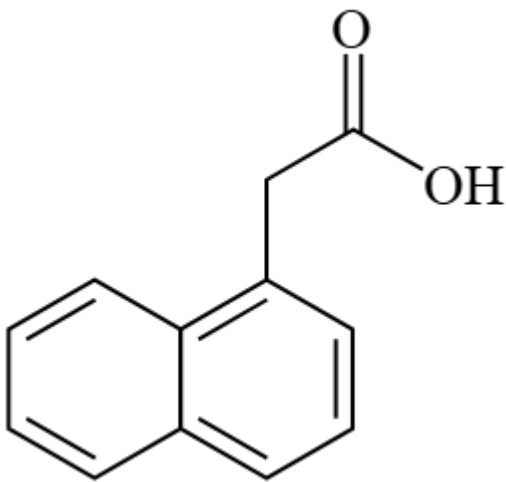


# Root-applied auxins in hydroponics: where they help, where they don't

## Introduction

Auxins can modulate root architecture, fruiting and stress responses. In hydroponic and substrate soilless systems, exogenous **root-zone** applications at very low ppm sometimes boost yield or quality. Push the dose and you flip the response. Below I review peer-reviewed work on widely grown crops, focusing on species, timing, exact dosages converted to ppm, and toxic thresholds. Where possible I prioritize reviews to frame context, but yield data come from primary trials.



Model representation of the NAA molecule, a very commonly used auxin in plant culture.

## Evidence & discussion

**Sweet pepper.** Two lines of evidence exist. First, fertigation with a commercial IBA product at **0.4 percent** active (4000 ppm in the stock) applied **weekly from early fruit development** at **0.5 L ha<sup>-1</sup>** outperformed **1.0 L ha<sup>-1</sup>**, increasing marketable

yield while improving root mass and water and nutrient uptake in perlite culture [\(1\)](#). Second, a separate trial compared **root fertigation vs foliar** using a formulation containing **6.75 g L<sup>-1</sup> NAA** and **18 g L<sup>-1</sup> NAA-amide**. The fertigation rate was **0.6 mL L<sup>-1</sup>** of product in the solution, equal to **~4 ppm NAA** plus **~10.8 ppm NAA-amide** per application; foliar used **0.4 mL L<sup>-1</sup>** or **~2.7 ppm NAA** plus **~7.2 ppm NAA-amide**. Early and total yield were higher with fertigation, while foliar favored some quality traits like firmness and soluble solids [\(5\)](#). Practical read: peppers respond to root-zone auxin in the **single-digit ppm** range, but more is not better.

**Melon.** The same IBA approach that helped pepper flopped in melon. In perlite greenhouse culture, **0.4 percent IBA** applied **weekly** at **0.5 or 1.0 L ha<sup>-1</sup>** did **not** improve yield or water or nutrient relations. Authors concluded it is not an effective tool for commercial melon in soilless culture [\(2\)](#). Species matter.

**Strawberry.** In long recirculating systems, autotoxic phenolics depress growth and fruiting. A **one-time root or crown dip** in **NAA before transplant** at **5.4 μM NAA**, which is **~1 ppm**, mitigated autotoxicity and restored flower and fruit numbers compared with untreated plants. A higher **54 μM** dose, about **10 ppm**, was less effective [\(3\)](#). Timing was everything.

**Toxic thresholds from hydroponic seedlings.** While not a yield trial, maize in nutrient solution shows the margins. IBA at **10<sup>-11</sup> M** is **~0.000002 ppm** and stimulated root growth, but **10<sup>-7</sup> M** is **~0.02 ppm** and significantly stunted primary root elongation and biomass. The same hormone switches from helpful to harmful across four orders of magnitude [\(4\)](#). That narrow window explains why melon trials can miss and pepper trials can hit. For broader context on root-zone biostimulation via fertigation programs, see this review [\(6\)](#).

# Tables

**Table 1. Positive responses to exogenous auxin at the root zone in soilless crops**

| Crop & system          | Auxin and delivery                      | Dose in root zone (ppm)                                            | Timing                       | Outcome                                                                                                                         |
|------------------------|-----------------------------------------|--------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Sweet pepper, perlite  | IBA 0.4 percent product via fertigation | Stock is <b>4000</b> ; applied <b>0.5 L ha<sup>-1</sup> weekly</b> | From early fruit development | Higher marketable yield at 0.5 vs 1.0 L ha <sup>-1</sup> ; improved root mass and water and nutrient uptake <a href="#">(1)</a> |
| Sweet pepper, soilless | NAA + NAA-amide via fertigation         | ~ <b>4</b> NAA + ~ <b>10.8</b> NAA-amide per application           | Weekly during production     | Higher early and total yield vs foliar; foliar favored firmness and °Brix <a href="#">(5)</a>                                   |

| Crop & system                         | Auxin and delivery    | Dose in root zone (ppm)                        | Timing                 | Outcome                                                                                                 |
|---------------------------------------|-----------------------|------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------|
| Strawberry, recirculating hydroponics | NAA root or crown dip | ~ <b>1</b> optimal; ~ <b>10</b> less effective | One time at transplant | Mitigated autotoxic yield loss; restored flower and fruit counts under closed reuse <a href="#">(3)</a> |

**Table 2. Null results and toxic thresholds**

| Crop or context                   | Auxin & delivery                | Threshold or tested dose (ppm)                                 | Timing              | Result                                                                                              |
|-----------------------------------|---------------------------------|----------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------|
| Melon, perlite greenhouse         | IBA 0.4 percent via fertigation | Stock <b>4000</b> ; <b>0.5 or 1.0 L ha<sup>-1</sup> weekly</b> | Season-long         | No improvement in yield or water or nutrient relations <a href="#">(2)</a>                          |
| Maize seedlings, hydroponic assay | IBA in solution                 | <b>0.000002</b> stimulatory vs <b>0.02</b> inhibitory          | Continuous exposure | Root growth stimulation at ultra-low ppm but marked stunting by <b>0.02 ppm</b> <a href="#">(4)</a> |

# Conclusion

Root-applied auxins are not a silver bullet. They can raise yield or preserve quality, but only when dose and timing line up with the crop's physiology. Peppers respond to **single-digit ppm** root fertigation with higher early and total yields, while melons do not. Strawberries benefit from a **~1 ppm** pre-plant dip that preempts autotoxicity, whereas **~10 ppm** underperforms. Hydroponic seedling work reinforces the risk: **~0.02 ppm** IBA already suppresses maize roots. The safe play is to trial low, crop-specific ppm near published values, apply at the stage that matters, and stop if marketable yield does not move. If you treat auxins like a nutrient and "turn them up," they will punish you. If you treat them as a precise signal, they can pay off.