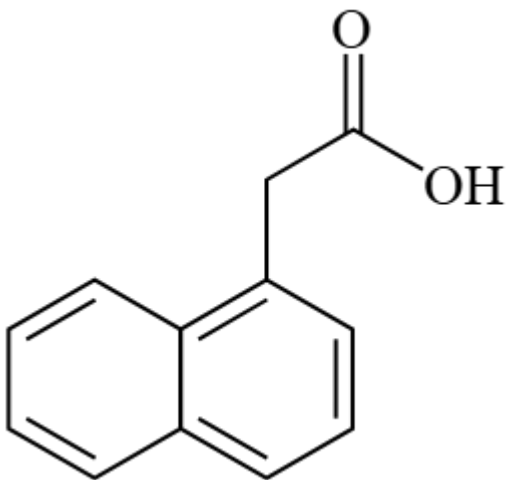


Root-applied auxins in hydroponics: where they help, where they don't

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⁻¹** outperformed **1.0 L ha⁻¹**, 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⁻¹ NAA** and **18 g L⁻¹ NAA-amide**. The fertigation rate was **0.6 mL L⁻¹** of product in the solution, equal to **~4 ppm NAA** plus **~10.8 ppm NAA-amide** per application; foliar used **0.4 mL L⁻¹** 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⁻¹** 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 **10⁻¹¹ M** is **~0.000002 ppm** and stimulated root growth, but **10⁻⁷ 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 4000 ; applied 0.5 L ha⁻¹ weekly	From early fruit development	Higher marketable yield at 0.5 vs 1.0 L ha ⁻¹ ; improved root mass and water and nutrient uptake (1)
Sweet pepper, soilless	NAA + NAA-amide via fertigation	~4 NAA + ~ 10.8 NAA-amide per application	Weekly during production	Higher early and total yield vs foliar; foliar favored firmness and °Brix (5)

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

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 4000; 0.5 or 1.0 L ha ⁻¹ weekly	Season-long	No improvement in yield or water or nutrient relations (2)
Maize seedlings, hydroponic assay	IBA in solution	0.000002 stimulatory vs 0.02 inhibitory	Continuous exposure	Root growth stimulation at ultra-low ppm but marked stunting by 0.02 ppm (4)

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.