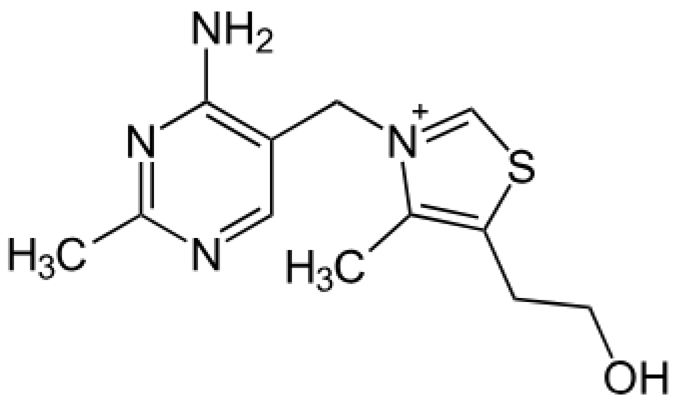
Thiamin as a biostimulant in hydroponic and soilless systems

Vitamin B1 (thiamin) is one of those additives that has circulated through the hydroponic community for decades, but the science behind its actual effects on plant growth has remained somewhat murky for most growers. Many products marketed for hydroponic use contain thiamin as part of their formulation, yet few growers understand when and how pure thiamin applications can genuinely benefit their crops. After reviewing the peer-reviewed literature on this topic, I want to share what the science actually tells us about using thiamin as a biostimulant in soilless cultivation.



Model representation of the thiamin molecule (vitamin B1).

What makes thiamin work in plants

Thiamin functions as an essential cofactor in central plant metabolism. The active form, thiamin diphosphate, participates directly in the tricarboxylic acid cycle, pentose phosphate pathway, and amino acid biosynthesis (1). Plants can synthesize their own thiamin, but research has demonstrated that exogenous application of pure thiamin can enhance growth, particularly when plants face environmental stress. This is not simply a case of feeding plants something they lack.

Rather, thiamin appears to act as a signaling molecule that upregulates stress-responsive genes and activates calcium signal transduction pathways in plant cells.

The most pronounced effects of thiamin application occur under abiotic stress conditions like drought and salinity. Under these circumstances, thiamin triggers the antioxidant defense system, helping plants manage reactive oxygen species that would otherwise cause cellular damage. This stress-protective role explains why many of the most impressive results in the scientific literature come from studies conducted under suboptimal growing conditions rather than ideal environments.

Foliar applications show the strongest yield effects

The bulk of the peer-reviewed research on thiamin as a biostimulant has focused on foliar spray applications rather than root-zone delivery. I would suggest growers interested in experimenting with thiamin consider foliar application as their primary method based on the current evidence.

One particularly well-designed study on pea plants tested foliar thiamin at concentrations of **250 ppm and 500 ppm** under both normal and drought conditions (2). The results were impressive: 500 ppm thiamin increased the number of pods per plant by **37 to 63%** depending on variety and stress level. Root length improved by **55 to 62%** compared to untreated controls. The researchers found that 500 ppm was more effective than 250 ppm across most parameters measured.

An older but highly cited field study from 1993 examined maize response to foliar thiamin at **100 ppm** applied during the vegetative stage at 30 and 45 days after sowing (3). This treatment increased grain yield by **20.2%** over untreated controls. The researchers attributed the yield boost to improved photosynthetic efficiency and delayed leaf senescence. This study is notable because it demonstrated yield improvements under normal field conditions, not just under stress.

Research on coriander and fenugreek in controlled greenhouse conditions tested three thiamin concentrations: **250, 500, and 750 ppm** (4). For coriander, 500 ppm proved optimal for vegetative growth, while 750 ppm produced the highest 1000-grain weight and elevated nitrogen and phosphorus content in the tissue. Fenugreek showed maximum vegetative response at 750 ppm, with improved chlorophyll, carotenoid, and phenolic content across all thiamin treatments.

Crop	Concentration (ppm)	Key Finding	Application Method
Pea	500	37-63% more pods per plant	Foliar spray
Maize	100	20.2% grain yield increase	Foliar spray at 30 and 45 DAS
Coriander	500-750	Best vegetative growth and grain weight	Foliar spray
Fenugreek	750	Maximum growth response	Foliar spray
Faba bean	100	Best yield under salt stress	Foliar spray at 30 and 45 DAS
Cauliflower	16000-33000	Improved biomass and antioxidants	Foliar spray

Evidence for root-zone applications in soilless systems

Root-zone thiamin application in true hydroponic or soilless systems has received far less research attention than foliar methods. This is an important point for hydroponic growers to understand. Most of what we know about thiamin comes from foliar studies or soil-based experiments, not from nutrient solution applications in recirculating systems.

One relevant study examined both root and shoot application of thiamin on sunflower grown in sand culture with nutrient solution (8). The researchers tested concentrations of **5 and 10 ppm** added to the root zone under salt stress conditions. Root-zone thiamin improved potassium uptake, maintained leaf water content, increased chlorophyll levels, and enhanced shoot and root dry mass. Both root and shoot applications were effective, with root application showing comparable benefits to foliar spray. This suggests that adding small amounts of thiamin directly to hydroponic nutrient solutions may provide stress protection for crops growing in challenging conditions.

For growers running hydroponic systems, I would recommend starting with concentrations in the **5 to 10 ppm** range for root-zone applications based on this evidence. Higher concentrations used in foliar studies may not be appropriate for continuous nutrient solution application.

Stress mitigation versus yield enhancement

One critical distinction that emerges from the literature is the difference between stress mitigation effects and yield enhancement under optimal conditions. Most studies demonstrating dramatic improvements from thiamin applications were conducted under some form of abiotic stress, typically drought or salinity.

Research on cauliflower under water deficit stress found that foliar thiamin at 16,864 to 33,727 ppm substantially improved plant biomass, photosynthetic pigments, and inflorescence quality (5). The treatment enhanced the antioxidant defense system and reduced hydrogen peroxide accumulation in stressed plants. Field trials on faba bean under salt-affected soil conditions showed that **100 ppm** thiamin caused the highest increases in growth and yield parameters, with significant improvements in carbohydrates, free amino acids, and proline content (6).

A recent 2024 study on faba bean under 100 mM NaCl salinity stress compared thiamin at **50 and 100 ppm** (7). The 100 ppm treatment promoted seedling fresh weight by 4.36 g and dry weight by 1.36 g versus controls. Total antioxidant capacity reached **28.14%** at 50 ppm thiamin under saline conditions. Chlorophyll b content increased by **209%** relative to controls with 100 ppm thiamin treatment.

Study	Stress Type	Thiamin Concentration	Key Quality Improvement
Pea 2023	Drought	500 ppm	Increased antioxidants and proteins
Cauliflower 2022	Water deficit	16,864-33,727 ppm	Enhanced phenolics and ascorbic acid
Faba bean 2019	Salinity	100 ppm	Higher carbohydrates and amino acids
Faba bean 2024	Salinity	50-100 ppm	209% chlorophyll b increase, 28% antioxidant capacity

For growers running well-optimized systems without significant environmental stress, the benefits of thiamin supplementation may be less pronounced than these studies suggest. The maize study showing 20% yield improvement under normal field conditions represents one of the few examples of substantial benefits without imposed stress. However, examples like these are not common in the literature.

Practical recommendations for hydroponic growers

Based on my review of the available peer-reviewed research, here are my suggestions for growers interested in experimenting with thiamin in their systems:

For foliar applications, concentrations between **100 and 500 ppm** appear most effective based on the literature. Applying at the vegetative stage and repeating applications at 2 to 3 week intervals follows the protocols used in successful studies. Adding a surfactant like 0.1% Tween-20 to foliar solutions improves leaf coverage and uptake.

For nutrient solution applications in hydroponic systems, lower concentrations of **5 to 10 ppm** are more appropriate based on the sand culture research. Be aware that thiamin can degrade in solution, particularly in the presence of light and at higher pH values. The stability of thiamin in recirculating nutrient solutions has not been well characterized, which represents a gap in the current research.

The strongest case for thiamin supplementation exists when crops face environmental stress. If your growing environment experiences temperature extremes, salt buildup in the root zone, or other suboptimal conditions, thiamin may provide meaningful protection. For well-optimized controlled environment systems running under ideal conditions, the benefits may be more modest.

Thiamin hydrochloride is the most commonly available and tested form. It dissolves readily in water and is relatively inexpensive compared to many specialty biostimulant products. This makes it an accessible option for growers who want to run their own trials.

The bottom line on vitamin B1

The peer-reviewed evidence demonstrates that pure thiamin applications can improve plant growth, yield, and quality, particularly under stress conditions. Foliar applications at 100 to 500 ppm have shown the most consistent positive results across multiple crop species. Root-zone applications in soilless systems remain less studied but appear effective at lower concentrations around 5 to 10 ppm.

Growers should approach thiamin with realistic expectations. It is not a magic yield booster that will transform mediocre results into exceptional harvests. Instead, it functions as a stress protector and metabolic support compound that can help plants maintain performance when conditions are challenging. The most significant benefits will likely be seen by growers dealing with environmental stress factors that are difficult to fully control.

For anyone interested in testing thiamin in their hydroponic or soilless systems, the research provides a solid foundation for experimental protocols. Start with the concentrations and application methods validated in the scientific literature, keep good records, and run proper controls. This is an area where thoughtful experimentation can help fill gaps in our understanding of how thiamin performs in recirculating hydroponic systems.

A practical note on foliar applications

One thing worth mentioning for growers planning to use thiamin as a foliar spray is the distinctive odor that develops as thiamin degrades. After application, particularly as the spray solution ages or when thiamin breaks down on leaf surfaces, you may notice a sulfurous smell. This is normal and results from the thiazole ring structure in the thiamin molecule, which contains sulfur. The smell is not an indication of any problem with the treatment, just a characteristic of thiamin chemistry. Some growers find it unpleasant, while others barely notice it. If you are working in an enclosed growing space, be aware that this odor may be noticeable for a period after spraying. This is simply something to factor into your application timing and ventilation planning.

Have you experimented with thiamin or other B vitamins in your hydroponic system? What results did you observe? Let us know in the comments below!