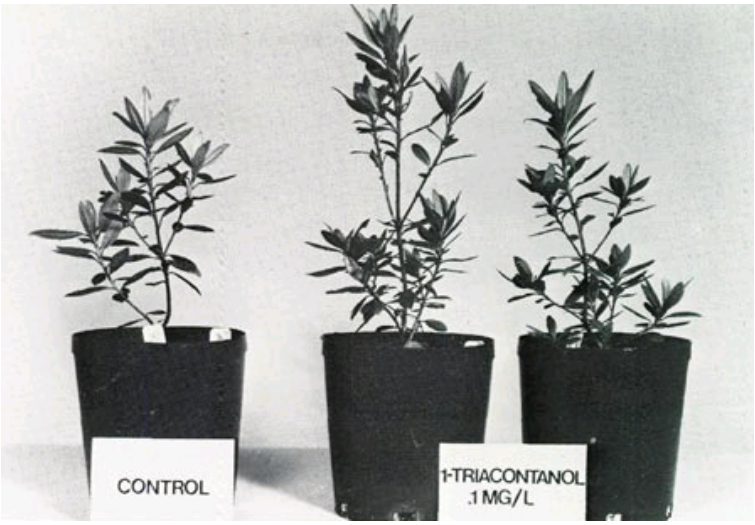
Using triacontanol to increase yields in hydroponics

Usually additives used in hydroponics need to be added in rather large quantities to obtain palpable results. Molecules like salicylic acid – which we have discussed before – need to be used in concentrations in the order of 10^{-4} to 10^{-2} M to obtain a significant effect. This means that you need to use quantities in the order of 20-150ppm of most additives in order to see a significant result. However there is a molecule called 1-triacontanol that can generate very significant results with only a fraction of that concentration. Today we will talk about this substance, what it does, how to use it and why it's such a desirable tool in your hydroponic additive arsenal. Many of the things I will talk about in this article are derived from this 2011 review on triacontanol (make sure you read that for a deeper insight into why this molecule works).

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Triacontanol is a very long fatty alcohol. Each molecule has 30 carbon atoms linked in a linear structure which makes this molecule extremely hydrophobic and hence very hard to dissolve in something like water. Using triacontanol therefore involves dissolving this molecule in something other than water – for example Tween 20, chloroform, methanol – before adding water in order to prepare an emulsion for use in either root applications or foliar feeding. Most research using triacontanol has used foliar feeding as this is the easiest way to control the application of the molecule and also how it seems to have the largest effect.

The effects of this molecule are not short of miraculous. Triacontanol is usually applied in concentrations on the order of 10^{-7} to 10^{-9} M, which means it is used from around 0.01 to 1 ppm. This means that we use about 1000 times less triacontanol than other additives in order to obtain a meaningful result. The table below shows some of the effects that triacontanol has showed in peer reviewed studies, with plant height, weight and yields increasing across a variety of different species, from tomatoes to japanese mint. Papers on other plants besides those on the chart have also been published, for example triacontanol has showed to significantly increase yields in lettuce crops (here). Some studies have also found that the effect of triacontanol can also be enhanced through the use of magnesium or in conjunction with other hormones (here).

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Table 1 Positive response of various plant species to foliar application of triacontanol.

Name of plant	Botanical name	Family name	Growth attributes	Yield attributes	Biochemical attributes	Quality attributes	Reference citation
Opium poppy	*Papaver somniferum* L.	Papaveraceae	Plant height, dry weight and number of branches	Number of capsules, seed yield per plant, and crude opium yield per plant	Chl *a*, Chl *b*, and total content	Morphine content and morphine yield per plant	Khan et al. (2007)
Tomato	*Solanum lycopersicum* L.	Solanaceae	Height per plant, number of leaves and plant fresh and dry weights	Number of fruits per plant, weight per fruit and fruit yield per plant	Total chl and carotenoids content, leaf-N, -P, and -K contents	Fruit ascorbic acid and lycopene contents	Khan et al. (2009)
Hyacinth bean	*Lablab purpureus* L.	Fabaceae	Plant fresh and dry weights, leaf-area per plant, number and dry weights of nodules	Number of pods per plant, number of seeds per pod, 100-seed weight and seed-yield per plant	Photosynthetic rate (P_N), stomatal conductance (gs) and transpiration rate, total chl and carotenoid content, NR and CA activities, leaf-N, -P, -K, and -Ca content, nodule-N and leghemoglobin contents	Seed-protein content, total carbohydrate content, and tyrosinase activity	Naeem and Khan (2005), Naeem et al. (2009)
Artemisia	*Artemisia annua* L.	Asteraceae	Shoot and root lengths, plant fresh and dry weights	Artemisinin yield	P_N, gs and transpiration rate, total chl and carotenoid content, NR and CA activities, leaf-N, -P, and -K content	Essential oil content, artemisinin content	Aftab et al. (2010)
Coriander	*Coriandrum sativum* L.	Umbelliferae	Shoot and root lengths, plant fresh and dry weights		Total chl and carotenoids content, NR and CA activities, leaf-N, -P, and -K content	Essential oil content	Idrees et al. (2010)
Coffee senna	*Senna occidentalis* L.	Fabaceae	Plant fresh and dry weights	Number of pods per plant, number of seeds per pod, 100-seed weight and seed yield per plant	P_N, gs and transpiration rate, total chl and carotenoid content, NR and CA activities, leaf-N, -P, -K, and -Ca content	Total anthraquinone and sennoside contents, and seed-protein content	Naeem et al. (2010)
Sweet basil	*Ocimum basilicum* L.	Labiatae	Shoot and root lengths, number of spikes per plant, total leaf area, plant fresh and dry weights	Essential oil yield	Chl *a*, Chl *b*, total Chl, and carotenoid contents, activities of NR and CA, leaf-N, -P, and -K contents	Leaf-protein and carbohydrate contents, essential oil content, linalool, methyl eugenol, and eugenol contents	Hashmi et al. (2011)
Japanese mint	*Mentha arvensis* L.	Lamiaceae	Plant height, leaf-area, leaf-yield, and plant fresh and dry weights	Herbage yield, essential oil yield	Total chl and carotenoid contents, activities of NR and CA, leaf-N, -P, and -K contents, total phenol	Essential oil content, menthol, L-menthone, isomenthone, and menthyl aceteate contents	Naeem et al. (2011)

Abbreviation: Chl, Chlorophyll; NR, Nitrate reductase; CA, Carbonic anhydrase.

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With such an impressive array of effects and such a low expected toxicity – due to its very low solubility – it's definitely one of the best additives to use to get production gains in hydroponic crops. This also makes it one of the most commonly used substances in commercially available grow enhancers. Nonetheless since it's used in such a small quantity it's very easy for someone to buy a small amount of triacontanol and use it for years before running out. You can buy small amounts of triacontanol as a powder (there are several reputable sellers on ebay) and you can then prepare your own concentrated triacontanol solution in Tween 20 – not water – that will last you for ages. A liter of 2000ppm solution of triacontanol will last you for 1000-2000 liters of foliar spray. You cannot get more economical than that.

The optimum application rate and frequency for triacontanol varies across different species but if you want to take an

initial guess use a foliar application of a 0.5 ppm solution every week. There is usually a sweet spot for concentration – after that you start to see a decrease in results compared to the highest point – so you want to start below a 1 ppm application rate. For some crops repeated applications might be unnecessary – with just one or two applications giving most of the effect through the entire crop cycle – while for others you do want to apply every week. How you initially dissolve the triacontanol to make your concentrated solution is also important with Tween 20 being the most ecologically friendly – although not the easiest – option.