Organic Crop Production in Hydroponic Systems: Fertilizer Basics

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What is an organic product?

An agricultural product is considered as organic if it is produced

- without the use of prohibited synthetic or non-synthetic materials
- on land to which prohibited chemicals were not added in the three years preceding harvest
- in compliance with an organic plan agreed between the producer or handler and certifying agent

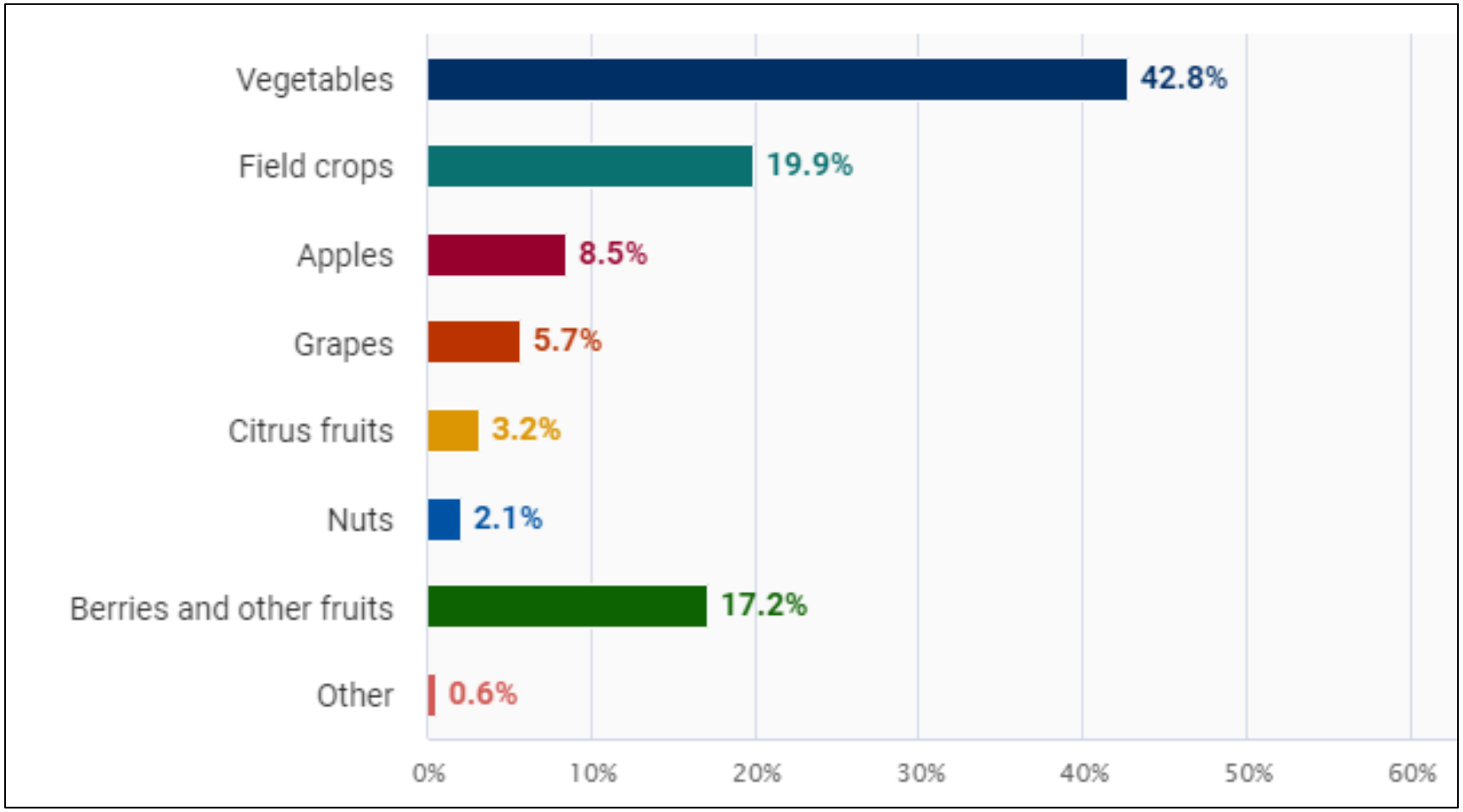
National Organic Program (NOP)

Under the Organic Food Production Act (1990), a National Organic Program (NOP) was established within USDA by the Secretary of Agriculture to implement organic certification program for producers and handlers of organic products

Organic Label Categories

100% certified ingredients	95% certified ingredients	70% certified ingredients	Less than 70% certified ingredients

Organic Market Segmentation in the US



Lettuce is the largest source of revenue within vegetables

Revenue $4.5 billion in 2020 (source: IBIS World)

Organic Hydroponics

- Hydroponically produced crops can receive USDA certification as long as the certifier can demonstrate that the crop is produced in a way that complies with the standard guidelines

Hydroponic Production (with standards)

Price difference: Conventional vs Organic

Product	Conventional ($)	Organic ($)
Romaine Lettuce (3 pk)	2.07	3.11

A premium of nearly 50% is charged for organic compared to conventional lettuce

Source:
Islam S, Colonescu C. Data on retail price differential between organic and conventional foods. Data Brief. 2019;27:104641. Published 2019 Oct 11. doi:10.1016/j.dib.2019.104641

Organic Hydroponic Production Protocol

Seeds from organically grown plants + Peat media in containers + Organic fertilizers (OMRI approved) + No pesticide or chemical sprays + Irrigation water should not contain fertilizers

There are 14 essential elements required for plant growth and development

Category	Element (Symbol)	Tissue Content (%)
Primary Macronutrients	Nitrogen (N)	4
	Phosphorus (P)	0.5
	Potassium (K)	5
Secondary Macronutrients	Calcium (Ca)	0.5
	Magnesium (Mg)	0.3
	Sulfur (S)	0.3
Micronutrients	Iron (Fe)	0.0015
	Manganese (Mn)	0.0005
	Molybdenum (Mo)	0.0005
	Boron (B)	0.0003
	Copper (Cu)	0.0002
	Zinc (Zn)	trace
	Nickel (Ni)	trace
	Chlorine (Cl)	trace

Organic Fertilizer

+ microbes

+ water

NO_3^- PO_4^{3-} K^+

NH_4^+ Ca^{2+}

Fe^{3+} Mg^{2+}

Absorbed by plants

Synthetic Fertilizer

+ water

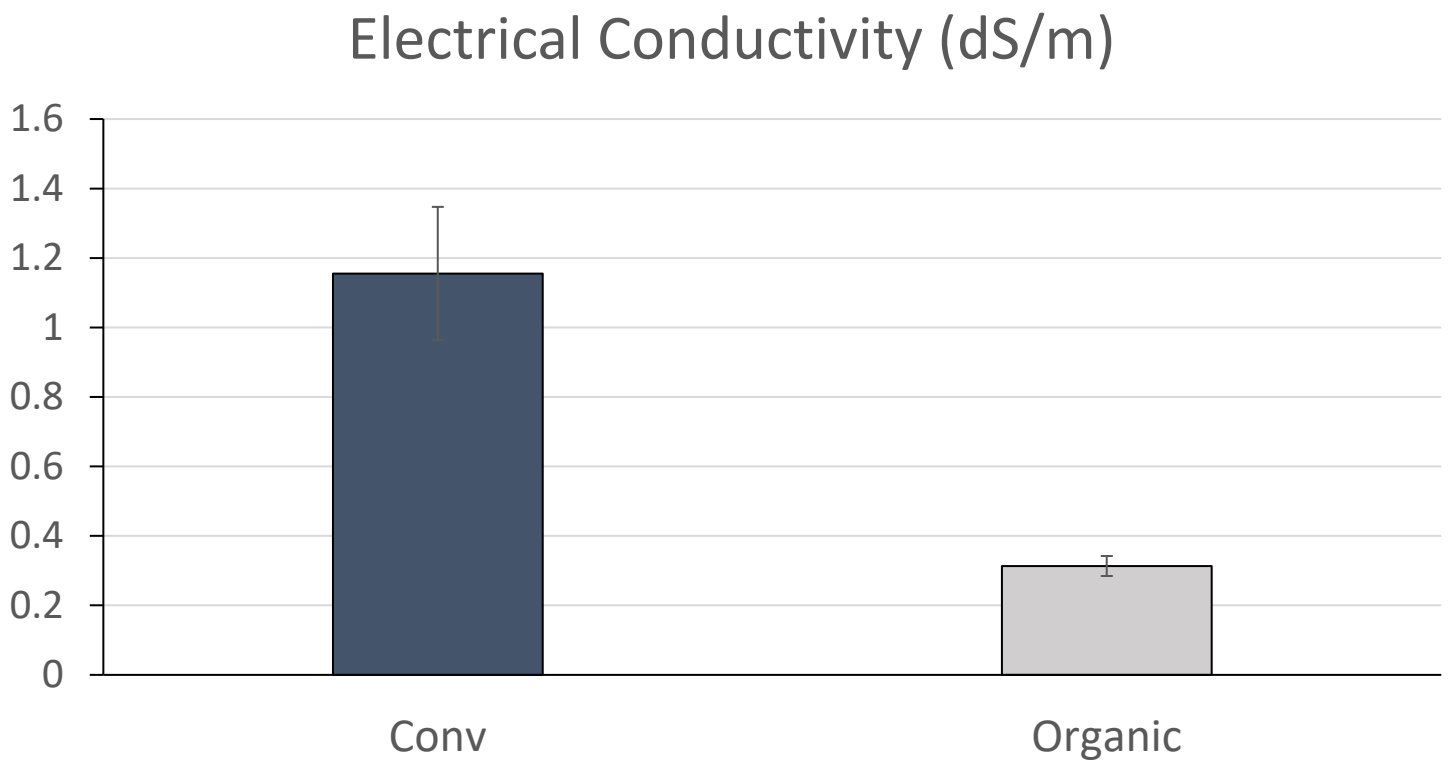
NO_3^- PO_4^{3-} K^+

NH_4^+ Ca^{2+}

Fe^{3+} Mg^{2+}

Absorbed by plants

Electrical conductivity indicated lower concentration of plant nutrients in substrate supplied with organic fertilizer

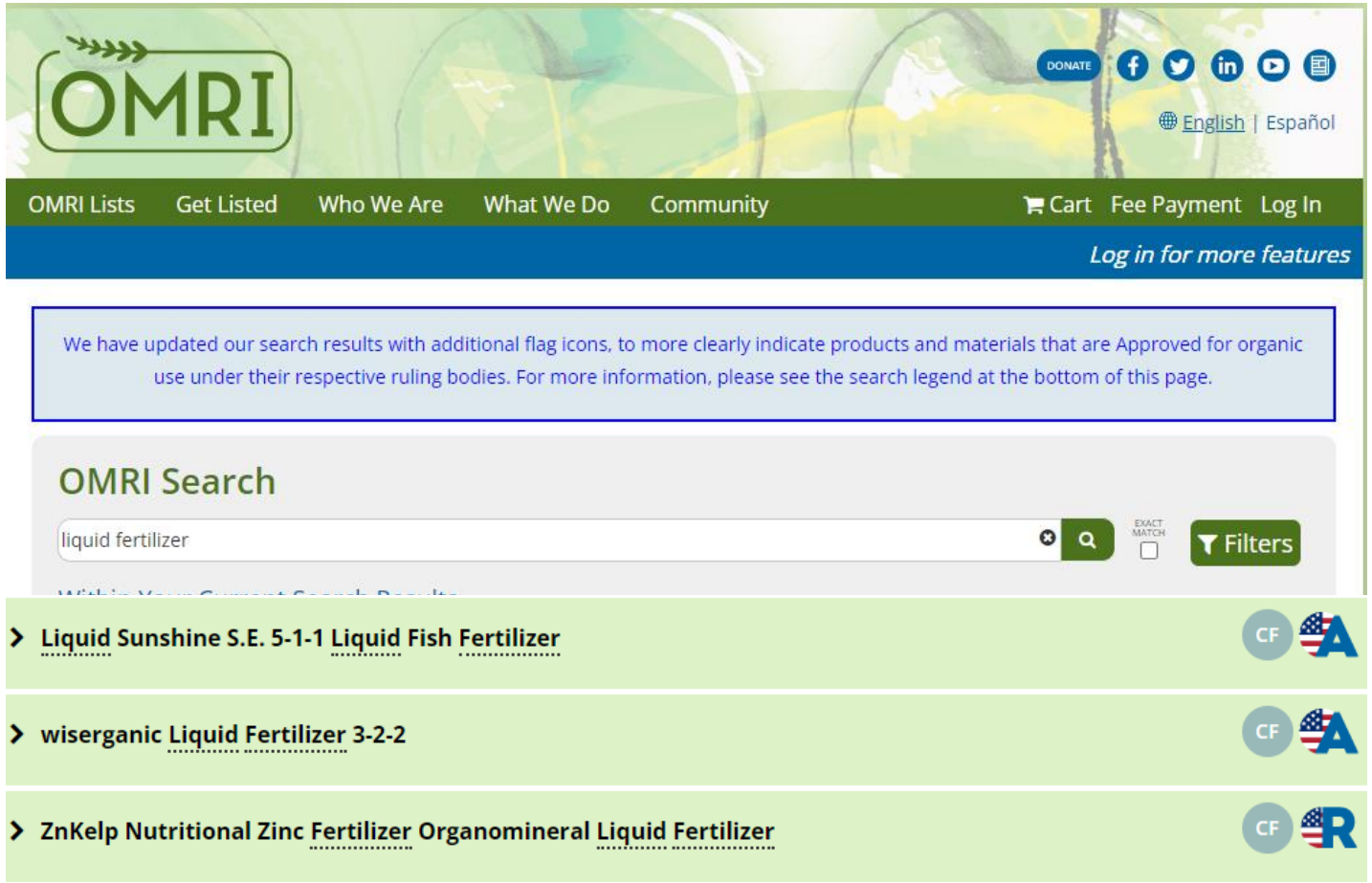


Developing fertilizer recipes

How do you find the certified organic fertilizer?

OMRI-Organic Material Review Institute lists organic fertilizers

[OMRI Search | Organic Materials Review Institute]



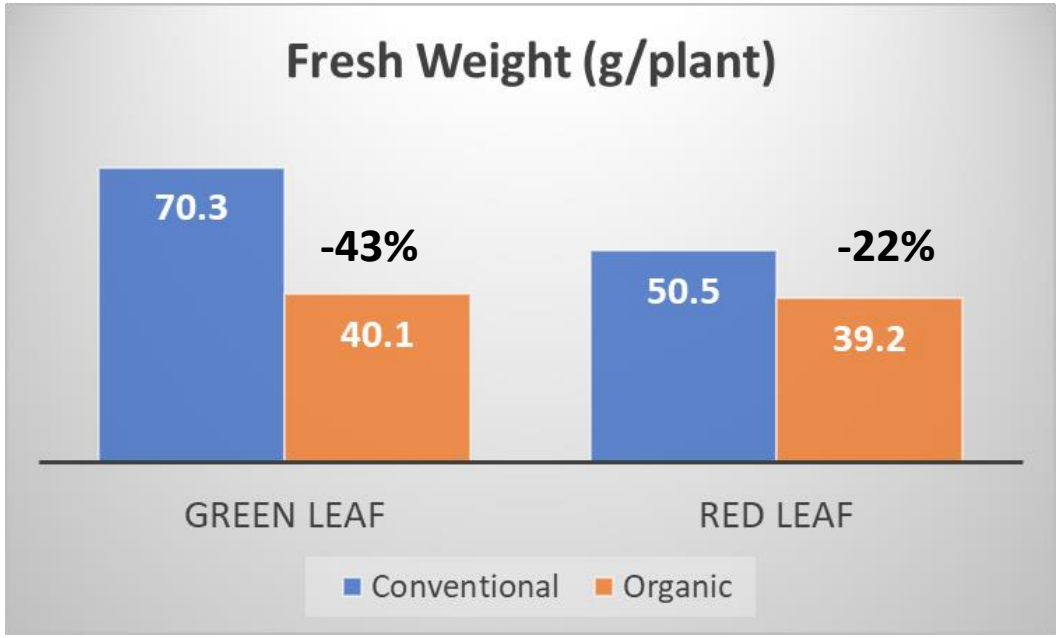
A Simple Organic Fertilizer Recipe

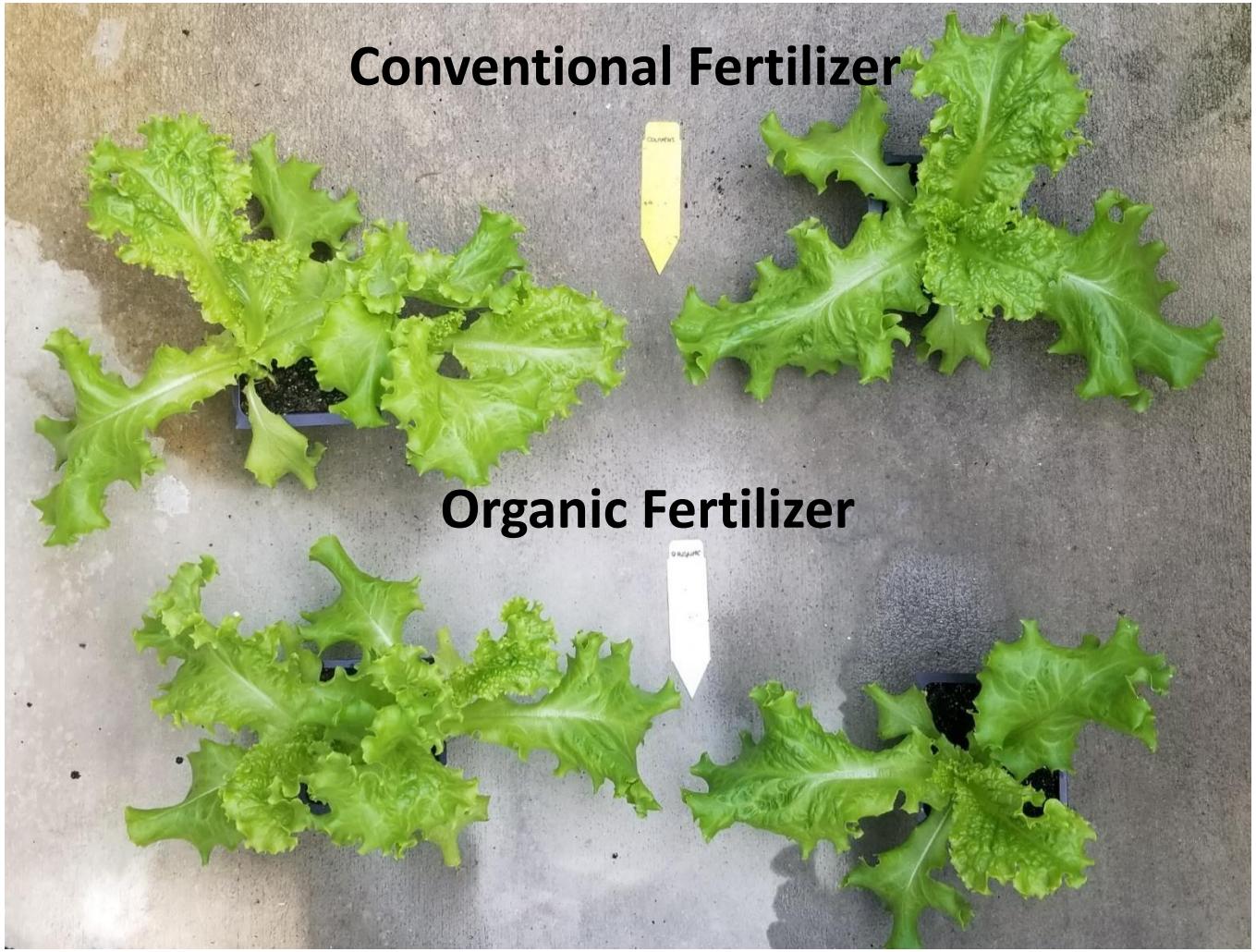
Following fertilizers can be combined and mixed with the substrate

Certified Organic Fertilizer	N (%)	P_2O_5 (%)	K_2O (%)	Ca (%)	Mg (%)	S (%)
7-5-7 (2X)	14	10	14			
Epsom (0.3 X)					2.9	3.9
4-3-2 (1.5X)	6	4.5	3	10.5		
TOTAL	**20**	**14.5**	**17**	**10.5**	**2.9**	**3.9**

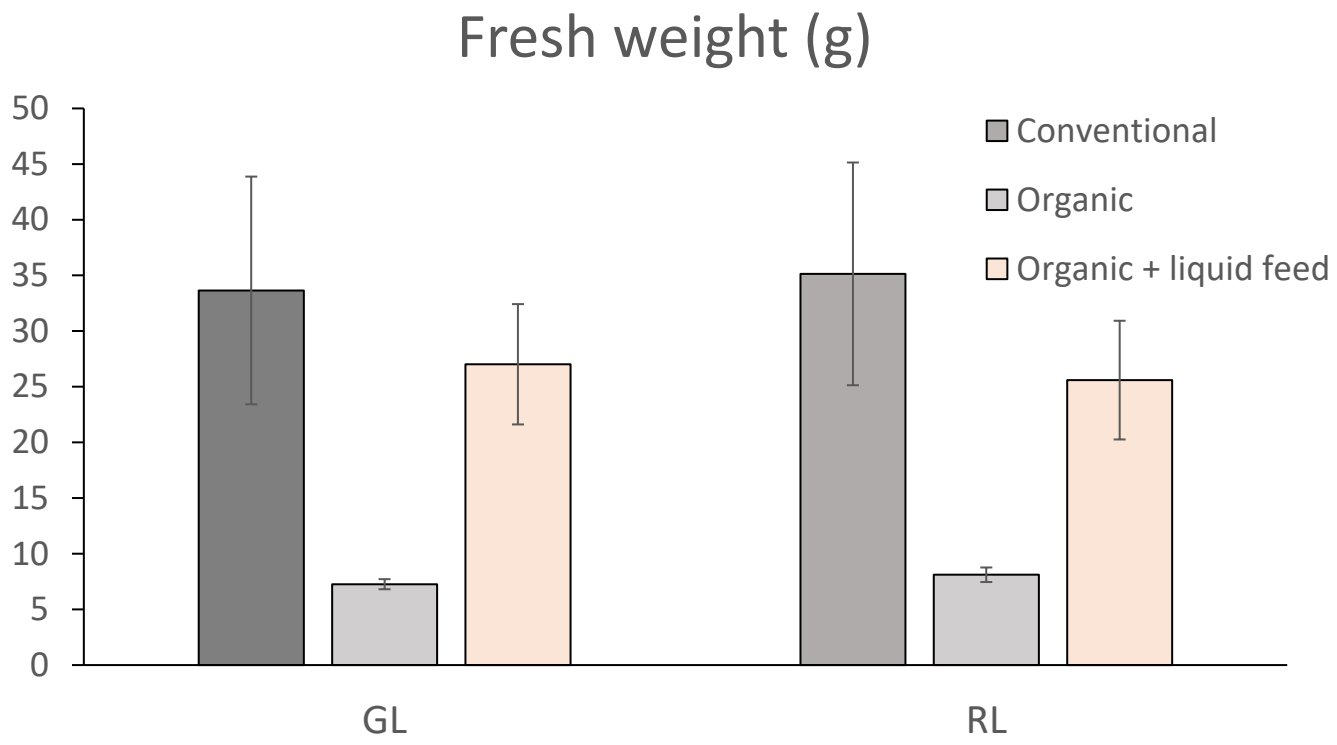
- If micro nutrient deficiency is observed, document (record) it and apply certified organic micronutrients
- Amount per container will depend on the electrical conductivity of the substrate. Add sufficient quantity of the mixture to result an electrical conductivity close to 1.0 dS/m

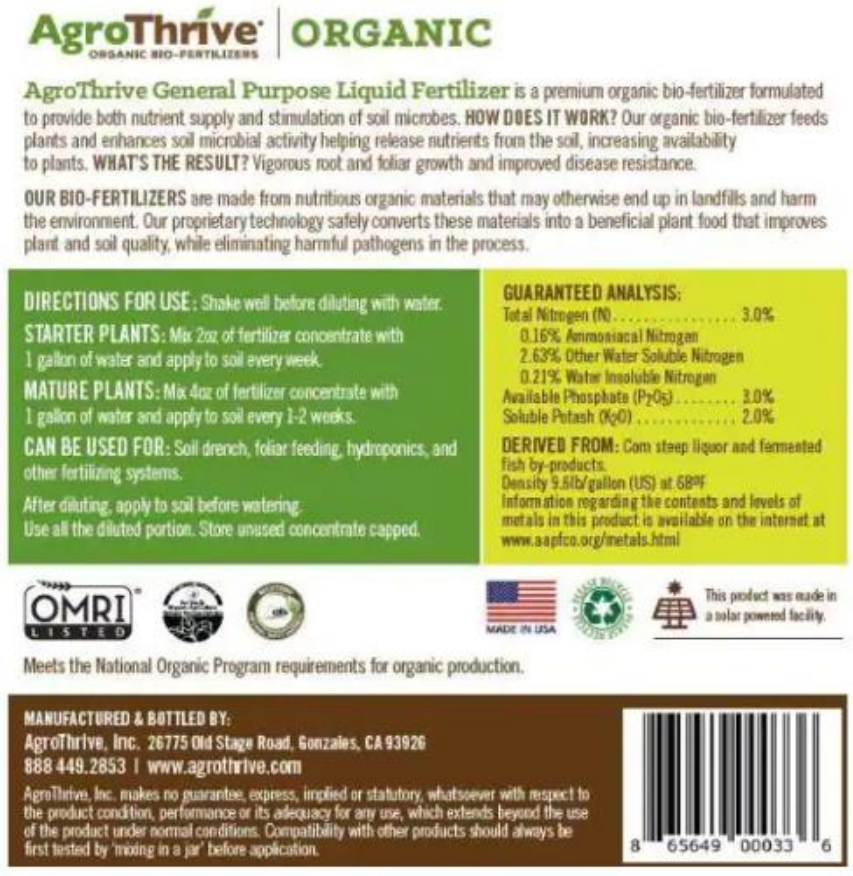
Lettuce weight in organic treatment was lower than conventional treatment





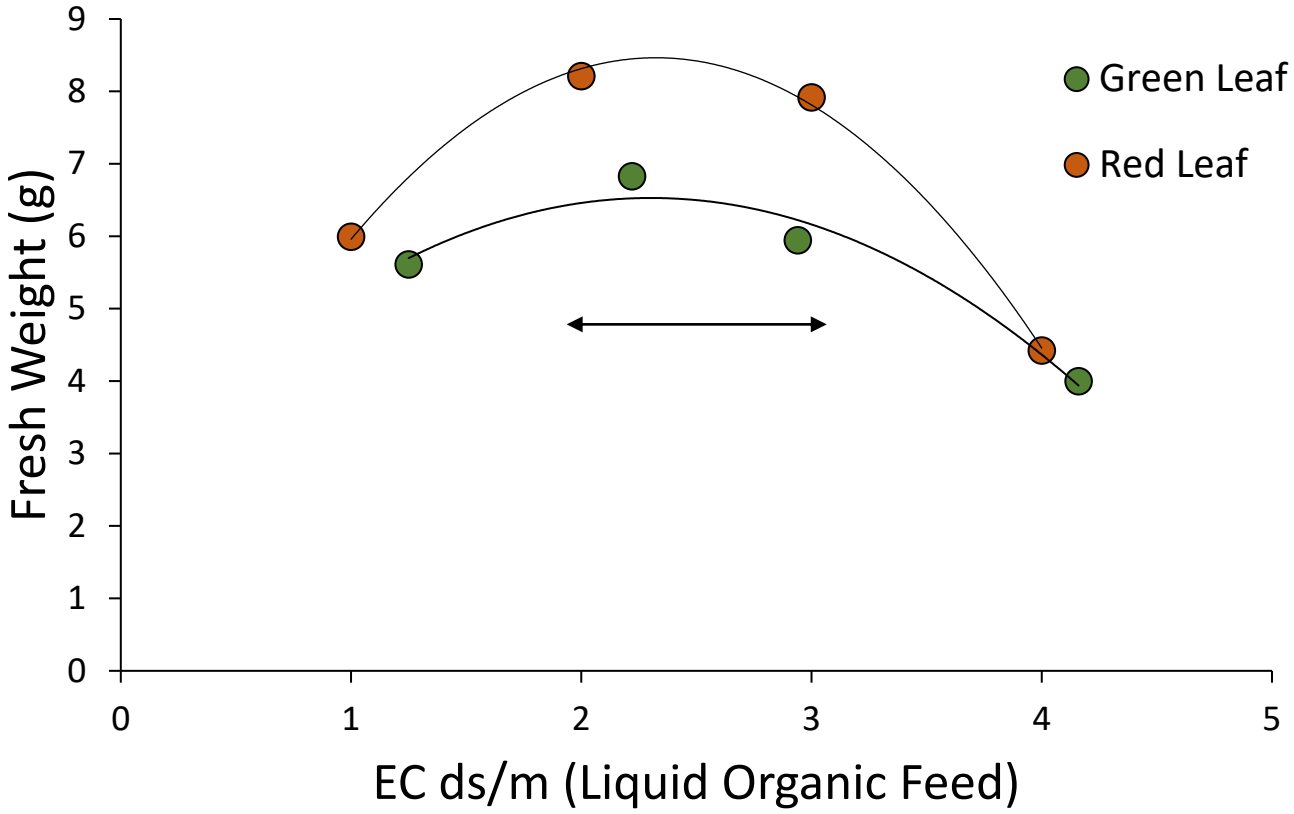
Organic liquid feed supplement increased yield





Liquid organic feed was supplied continuously through recycling irrigation water by mixing 10 ml per liter of water

A liquid organic feed concentration of 20 ml/L was optimal



Concentration (ml/L)	EC (dS/m)
10	1.25
20	2.22
30	2.94
40	4.16

Note: Organic fertilizer resulted in a substrate EC of 0.3 to 0.5 dS/m

Adding a liquid feed (3-3-2) of 20 ml/L as a supplement to 2g/ pot of organic fertilizer at least once a week is optimal. We will develop techniques in the future that further optimize liquid feed use.

Thank You!

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