



Stoller

Unleashing The Power Of Plants

> **MAKE YOUR FERTILISER COUNT**

**USING CHELATES TO INCREASE TRACE ELEMENT
(MICRONUTRIENT) UPTAKE AND FERTILISER USE EFFICIENCY**

One of the biggest factors limiting crop growth and yield is the level of nutrients available to the crop. Trace element levels in the soil aren't always sufficient for optimum crop growth, or they might be in a form that plants can't readily access. It's important to make sure that fertiliser use efficiency is high to get the best growth response from the crop and ensure you maximise every dollar.

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PLANTS NEED NUTRIENTS IN A FORM THEY CAN ABSORB

Most of the trace elements used in fertilisers start off as metal salts (e.g. zinc oxide, zinc sulphate) and while some of these salts are soluble, they can also react with other elements in the soil, spray tank or plant tissue. When these reactions take place, trace elements can be tied up in compounds that aren't water soluble or in a form that plants can't access.

In some cases, soil tests can show high levels of trace elements but tissue tests or plant symptoms indicate a deficiency. This means that trace elements aren't reaching the plant, and simply applying more of the same fertiliser won't be effective. Zinc and other trace elements often aren't very mobile within the plant, so trace elements need to be applied in a form that can be absorbed where plants need them most.

HOW DO CHELATES HELP?

One of the ways to prevent trace elements from reacting with other elements in the soil, spray tank or plant tissue is to bind them to another agent, forming a chelate. Chelate comes from the Greek word for claw. Chelating agents hold onto trace elements like a claw and stop them from binding to other elements - the end result is called a chelate. As a chelate, the trace element is in a more stable and water soluble form that plants can use.

USING A CHELATING AGENT:

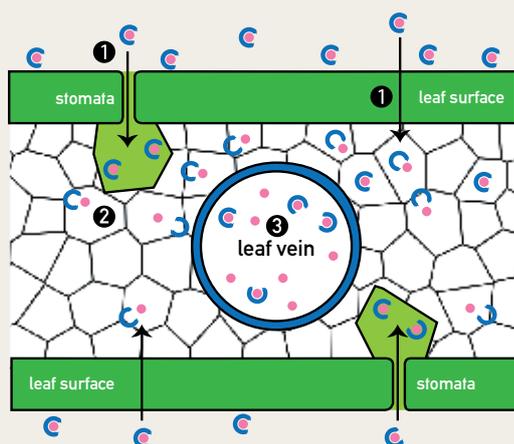
- protects the trace elements from binding to other elements

The chelating agent forms a strong bond with the element and ensures it gets to the plant. The chelating agent and each element have a 'charge'. Cations (positively charged ions e.g. zinc and magnesium) and anions (negatively charged ions e.g. phenolic acid) are like magnets, with positive and negative ions attracted to each other.

- improves application efficiency

More of the trace element applied is able to be absorbed by the plants, so less is needed to achieve the same result.

CHELATES MOVE EASILY THROUGH PLANTS



- The chelate enters the plant via stomata (pores), leaf surface and stems.
- The chelate enters plant cells and the nutrient is released.
- Veins carry the chelate throughout the whole plant.

WHAT IS A TRACE ELEMENT?

A trace element, also known as a micronutrient, is an element essential for plant growth but only needed in small amounts. Zinc, iron, manganese, molybdenum, copper, cobalt and boron are all trace elements.

CHELATING IN ACTION

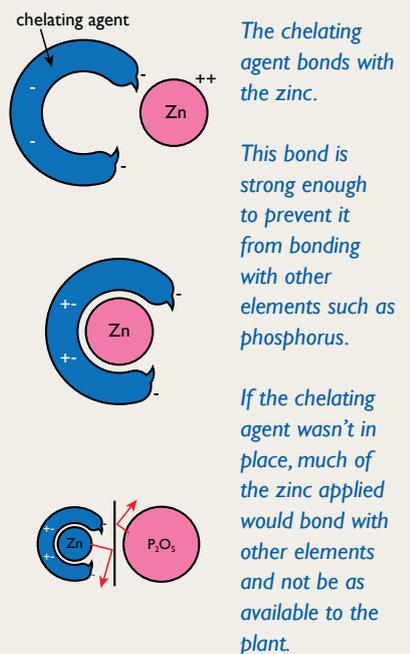


Diagram based on picture courtesy of Stoller USA.

WHAT MAKES A GOOD CHELATING AGENT?

A good chelating agent is one that makes strong bonds (log $k > 12$) of consistent strength across a range of nutrients, but still maintains a high availability of the nutrient to the plant. You can use the log K values to make comparisons among the different chelate fertilisers.

WHAT MAKES A GOOD CHELATE FERTILISER?

There are a range of different chelating agents that can be used to improve fertiliser efficiency and these can either be organic (e.g. phenolic acid, citric acid) or synthetic (e.g. EDTA, HEDTA) chelating agents.

Each chelating agent holds on or binds to nutrients at different strengths. The strength of these bonds (and the effectiveness of the chelate) can be measured using a log K value. This is an important feature of the different chelating agents and is a good measure to compare across products.

A high log K value (> 12) represents a strong bond between the chelate and nutrient. This means that the nutrient will be more available to the plant giving a stronger crop response. Chelates with a high log K value are also more stable in alkaline soils, keeping the nutrients in a plant available form for longer.

The same chelate can have different strength bonds (log K values) with different nutrients. It is important to choose a chelate that binds with a similar strength to a range of nutrients. If there is a weaker bond with one or two nutrients, these can be displaced and the crop will not see the benefit of all the different nutrients applied. This is another important factor to consider when comparing chelate fertilisers.

A good chelating agent is one that makes strong bonds (log $k > 12$) and is consistent across a range of nutrients.

PHENOLIC ACID

Phenolic acid is the main chelating agent used by Stoller as it creates strong bonds (log $K > 12$) with a wide range of nutrients.

Log K Values

The following table represents log K values for products available in USA in the 80's. The higher the Log K value, the better the response by the plant to the chelate. Stoller's Phenolic Acid chelating agent has a high and consistent Log K value for all elements.

Manufacturer	Chelate	Mg	Ca	Zn	Mn	Cu	Fe
Stoller	Phenolic Acid	18	18	18	18	18	14
Stoller	DTPA	9	16.5	18.1	15.1	21	28.6
Stoller	HEDTA	7	8	14.5	10.7	17.4	19.6
Dow-Hampshire	EDTA	8.7	10.5	16.5	14	18.8	25.1
Geigy	EDDHA	N/A	7.2	9.2	N/S	N/S	33
Hampshire	NTA	N/A	6.4	10.4	7.4	12.6	15.9
Ruffin	Citric Acid	2.8	N/A	4.5	3.4	6.1	3.2
	Poly Phosphates	3.2	N/A	2.5	5.5	3.5	4.1

Table courtesy of Stoller USA.

PHENOLIC ACID CHELATES:

- form a high strength and consistent bond with nutrients to prevent them reacting in the soil, spray tank or plant tissue
- can be used for soil, foliar and seed applications
- can be absorbed by plant roots, leaves, seeds and even woody stems/tree trunks
- help nutrients stay in a plant available form for longer in the soil
- move from wood tissue (bark and twigs) to new leaves (important in tree crops for trace elements like zinc that aren't as mobile through the plant)
- are based on more than 40 years of research and field testing.

Phenolic acid chelates meet the highest standards and are suitable for a wide range of applications. Stoller also offers an EDTA chelate, which is tailored for mixing with selected broadleaf herbicides.

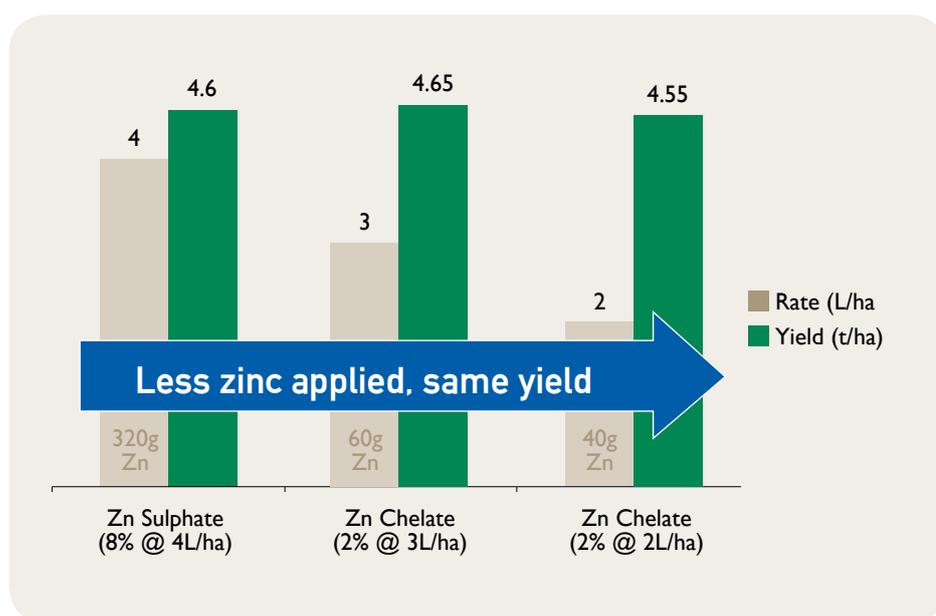
USING LESS NUTRIENTS TO ACHIEVE THE SAME RESULT

Example 1 - Wheat, Eyre Peninsula region, South Australia 2009

Chelated zinc applied to wheat was more than four times as efficient as foliar zinc sulphate applied to the same crop. Based on research trials from across the country, Stoller has generally found zinc application can be reduced by a quarter when using a chelated product (4kg Zn sulphate = 1kg Zn chelate).

Example 2 - Wheat, Mallee region, South Australia 2009

Leaf testing showed that nutrient uptake in wheat was 57% more efficient when chelated zinc and manganese was applied, compared to a foliar zinc and manganese oxide application.



Chelated zinc was more than four times as efficient as foliar zinc sulphate, while maintaining wheat yield (Eyre Peninsula region, SA 2009 – see example 1).

CHOOSING THE BEST OPTION

Since chelating agents were adopted in agriculture more than 50 years ago, many companies have come on the market with copies and variations of the phenolic compounds combined with nutrients. Globally, Stoller is one of the main developers of phenolic acid chelates and their formulations have been developed and proven over 40 years.

Trace element levels vary with different soil types and crops. It can be difficult to work out which trace elements plants need if you don't know what they already have. Soil and leaf tests are the best way to find out the levels of trace elements in your soil and plants. These tests can help you determine if nutrients are deficient, or if they are sufficient but just aren't getting to the plants. Get advice from an agronomist when interpreting soil and leaf tests - your Stoller supplier can also talk to you about the chelates that are right for your situation.

Your local representative

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