PETITION JUSTIFICATION STATEMENT.

Ammonium glycinate and Ammonium citrate.
Additional Information.
Sydney. 22 July 2016.

Please refer to the attached Diagrams:
- Diagram 2 : Correct understanding of chelating agents.
- Diagram 3: Incorrect understanding of chelating agents
- Diagram 4: Sustainable organic-certified agriculture.
- Diagram 6: Organic-certification for 'families' of chelating agents

In forwarding these Diagrams, we are responding further to a 17 May 2016 request from the Crops SubCommittee (CS) of NOP:-

"…explain why the petitioned substances would be better than the non-synthetic and/or synthetic chelating ages that are already allowed." (extract from USDA email dated 7 June 2016).

This whole topic of chelating agents and chelates is too significant, and too interesting, to constrain discussion to the limited dimension suggested by NOP at its May 2016 meeting.

Our submission is set out in the following sections:

1. Setting the context.
2. Diagram 2. Identification of the correct approach to manufacture chelating agents.
3. Technical reports quoted by Crops SubCommittee (CS).
4. Diagram 3. Illustration of the truncated approach documented by NOP.
5. How to imagine a solution to the problem ?
6. Specification of materials for chelate production.
7. Diagram 6. Recognising the existence of families of chelating agents.
8. Illustration of quantities of micronutrients needed in agriculture.
9. Request for granting Priority 1 to our Petition.
10. An integrated view of Agriculture as per Diagram 4 (attached).

1. Setting the context.

What we want to do is to obtain NOP approval for a system which delivers micronutrients to plants using organic-certified chelates.
This is our sole aim.
But:
- NOP is silent on chelates ('organo-metal-complexes'), and
- NOP prohibit consideration for approval of finished products chelates, and consequently
- We seek approval via Petition to NOP to use organic-certifiable precursers to chelates termed 'chelating agents', which themselves, by definition, are not finished products.

In view of the administrative possibilities still remaining open in NOP's rules, we seek organic-certified approval for the use of transient substances termed chelating agents. Chelating agents are not used on crops but are reacted further to form 'chelates' which **are** used on crops (if botanically and economically justified)
In our proposed production system, chelating agents will exist only within a reaction vessel and will exist only transiently in solution (refer to Diagram 2).

2. Diagram 2. Identification of the correct approach to manufacture chelating agents.

Diagram 2 (attached) shows the flow path of substances involved in formation of chelating agents and chelates.

Although the flow path is simple, we have found major misunderstandings about it within the organic-certification authorities around the world.

It is instructive to list the 9 chemical and agronomic concepts relevant to such a Diagram:-

acid / base / organic-chemistry salt / chelating agent / inorganic chemistry metal salt / chelate / nutrient removal analysis / nutrient replenishment rate / actual quantities of nutrients needed per acre.

3. Technical reports quoted by Crops SubCommittee (CS).

Two Technical Reports are quoted by CS as information sources; they are listed in the CS May and July 2016 Meeting Notes dealing with ammonium citrate and ammonium glycinate:-

- *2007 crops technical report for amino acids*
- *HS TR, Citric acid and salts, 2015*

Both these documents are in error.
They state that citric acid is a chelating agent.
It is not.
The chelating agent is the **salt** of citric acid - a citrate salt.
It is immediately clear from the 2007 and 2015 consultant's reports that the root cause of NOP's misunderstanding on chelating agents is an error documented by NOP's consultant.

4. Diagram 3: Illustration of the truncated approach documented by NOP.

Diagram 3 (attached) illustrates NOP's currently truncated understanding of chelate formation.
Of the 9 chemical and agronomic concepts identified as important in Diagram 2, Diagram 3 illustrates only 4 items:-

acid /—/—/ chelating agent /inorganic-chemistry metal salt / chelate /—/—/—

In NOP's approach:

- there is omission of an alkali
- formation of an organic-chemistry salt is impossible

- a belief exists, clearly based on a consultant's report, that citric acid and amino acid can act as chelating agents.

This is a deeply flawed approach with its source traceable to a decades-old report from a consultant external to NOP.
Quite apart from the source of the problem, it still needs NOP to fix it.

5. How to imagine a solution to the problem ?

Using an analogy of an electrical circuit:-

- in NOP's chemical circuit shown in Section 4, there is no 'continuity' between one end (an acid) and the other (a chelate). Just as no current flows in a faulty circuit, similarly nothing happens in NOP's truncated chemical circuit.
- if citric acid is characterised at 110 volts (say), its voltage must first be 'transformed' before it can work in a 220 volt citrate circuit; similarly citric acid must be transformed, this time chemically, a process termed 'neutralisation', before it can exhibit the properties of a chelating agent.
- and to complete the likeness, an 'integrated circuit' in electronics - and in chemistry - requires compatible components; this requirement is the most significant problem that needs to be tackled by NOP if a real chelating agent is to be formed. This is because it seems that a change in mind-set about permitting 'nature-identical' raw materials is needed in this specific, limited context of chelating agents.

6. Specification of materials for chelate production.

The specification problems that exist for correct materials selection in terms of 'quality' include:-

- which alkali should be allowed by NOP to neutralise citric acid and amino acid?
- what chemical species will exist in the raw material when 'natural amnio acids' are sourced for neutralisation reactions?…or is 'nature identical' amino acid to be acceptable in this specific , limited context with very low quantitative requirements?
- will there be consistency of species composition in the raw material if 'natural amino acid' is insisted upon?
- will purity specifications of 98-99% be accepted for amino acid and citric acid in the limited context of creation of chelating agents?

7. Diagram 6. Recognising the existence of families of chelating agents.

Diagram 6 (attached) illustrates the formation of 'families' of chelating agents.
It is seen that the choice of chelating agent, and hence chelate, is very wide.
The final choice of materials is often dependant more on price and availability of raw materials rather than on chemical performance.

A chelating agent is a 'salt', specifically, an organic-chemistry salt produced by neutralisation of an organic-chemistry acid with a base. Organic chemistry acids are those which contain one or more carboxylic groups —[COOH].

When the salt produced has the capacity to form at least 2 bonds to the central metal atom, that salt may be termed a 'chelating agent'.

The bonding to a central metal atom to form a chelate molecule may be made by either a carboxylate ion —$[COO]^-$ from a neutralised polycarboxylic acid , such as citric acid, or via one or more —$[NH_2]$ and —$[COO]^{-1}$ groups from a neutralised amino acid, such as glycine.

Diagram 6 shows that a salt with chelating-agent properties requires an acidic raw material component as well as an alkali raw material component.

The chemical convention of name change for the salt need to be respected:

citric acid produces 'citrate' salts.
lignosulphonic acid produces 'lignosulphonate' salts
glycine amino acid produces 'glycinate' salts.
sulphuric acid produces 'sulphate' salts.

It is worthwhile to stress that material selection and approval by NOP of raw materials in this specific , limited context needs to focus on the goal namely the production of reproducible, low cost, safe, and effective chelating agents which have no harmful effects on the environment, humans or plants.
The raw materials in our petition have the advantage that they are the simplest molecules existing in the universe, cheap, safe, non GMO and available, even in developing countries, as readily as chemicals for a school laboratory.

8. Illustration of quantities of micronutrients needed in agriculture.

Studies of nutrient removal rates in plants have shown the following:

N, P, K removal rates:	100- 200 kg per hectare.
Cu, Fe, Mn, Zn removal rates:	100-200 grams er hectare.

The point to make about this data is that micronutrient removal rates are one thousandth (1 / 1,000) of the removal rate of the major nutrients. Consequently, the requirements for chelates and chelating agents is very low. There can be no danger of pollution from the use of grams per hectare of a fertilising substance.

For example:
Copper range is 1-10 grams removed per ton per hectare.
Manganese range is 1- 50 grams removed per ton per hectare.
Zinc range is 1-25 grams removed per ton per hectare.

Using 28 grams per US ounce and 2.47 acre per hectare, the above data reduces to:

0.2 - 1 US ounce of micronutrient per ton per acre.

It is precisely because of the existence of these very small plant consumption rates that we urge that specialist attention be given when amending NOP documents dealing with chelating agents and chelates. The required quantities are low but the micronutrients are just as essential as the major NPK elements.

9. Request for granting Priority 1 to our Petition.

Our Petition involves a reconsideration of previous decisions on chelating agents.

We observe that Petitions of this type are given what is termed “Priority 1- above all other petitions”.
This would be appropriate in the case of our petitions too because of the evident error in NOP’s documents when dealing with chelating agents and in view of NOP’s silence on chelates.
It is not ideal that NOP’s conceptual errors have cascaded into OMRI and into the Australian Organic documents.
An expedited decision on our Petition in time for the Fall meeting in St. Louis Mo, on 16-18 November 2016, would enable a rapid correction - and expansion - to international organic documents on chelating agents and chelates using NOP as the lead authority.

10. An integrated view of Agriculture as per Diagram 4 (attached).

The utilisation of technical and crop data, of feedback loops and of feedforward loops in agriculture is shown on Diagram 4.
The relevance of this Diagram for chelating agents and chelates is that a farmer, wanting a specific yield, can ‘feedforward’ by ‘pre-positioning’ micronutrients and replenish the soil with the estimated quantities, at the time of sowing.
Unless a farmer replenishes the soil with nutrients removed, he will be ‘mining the soil’ and will eventually be non-sustainable.
In addition, unless the micronutrients applied are in a form suited to the pH of the soil, they will be useless. This is exactly the role of chelates, namely:

- that chelates protect trace element salts from precipitation reactions in soil,
- that chelates maintain micronutrients in a condition where they remain ‘available ‘ to plant roots.

Diagram 2: The correct 3-stage analysis for Chelate Production

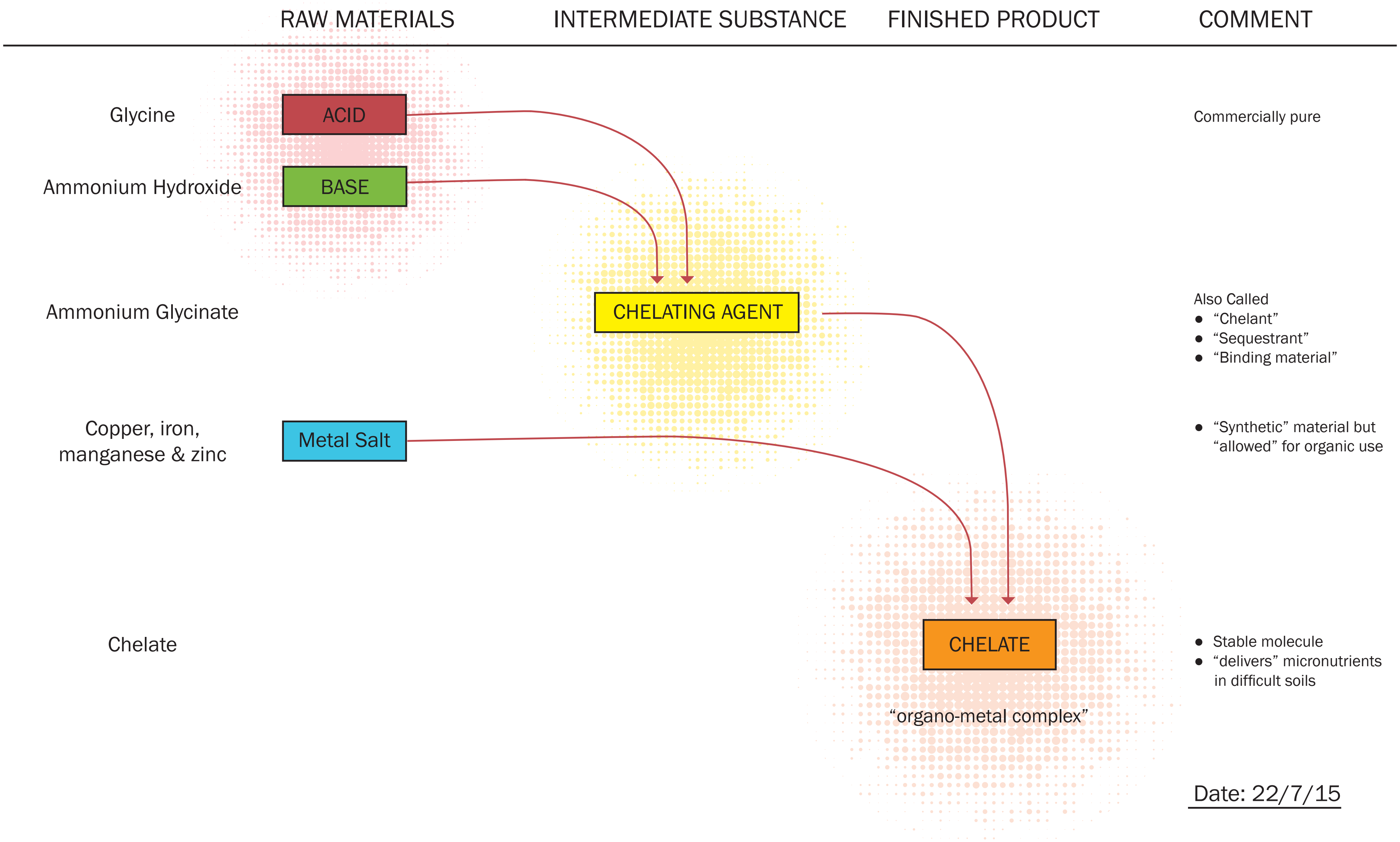

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Diagram 3: Erroneous 2-stage analysis by OMRI for Chelate Production

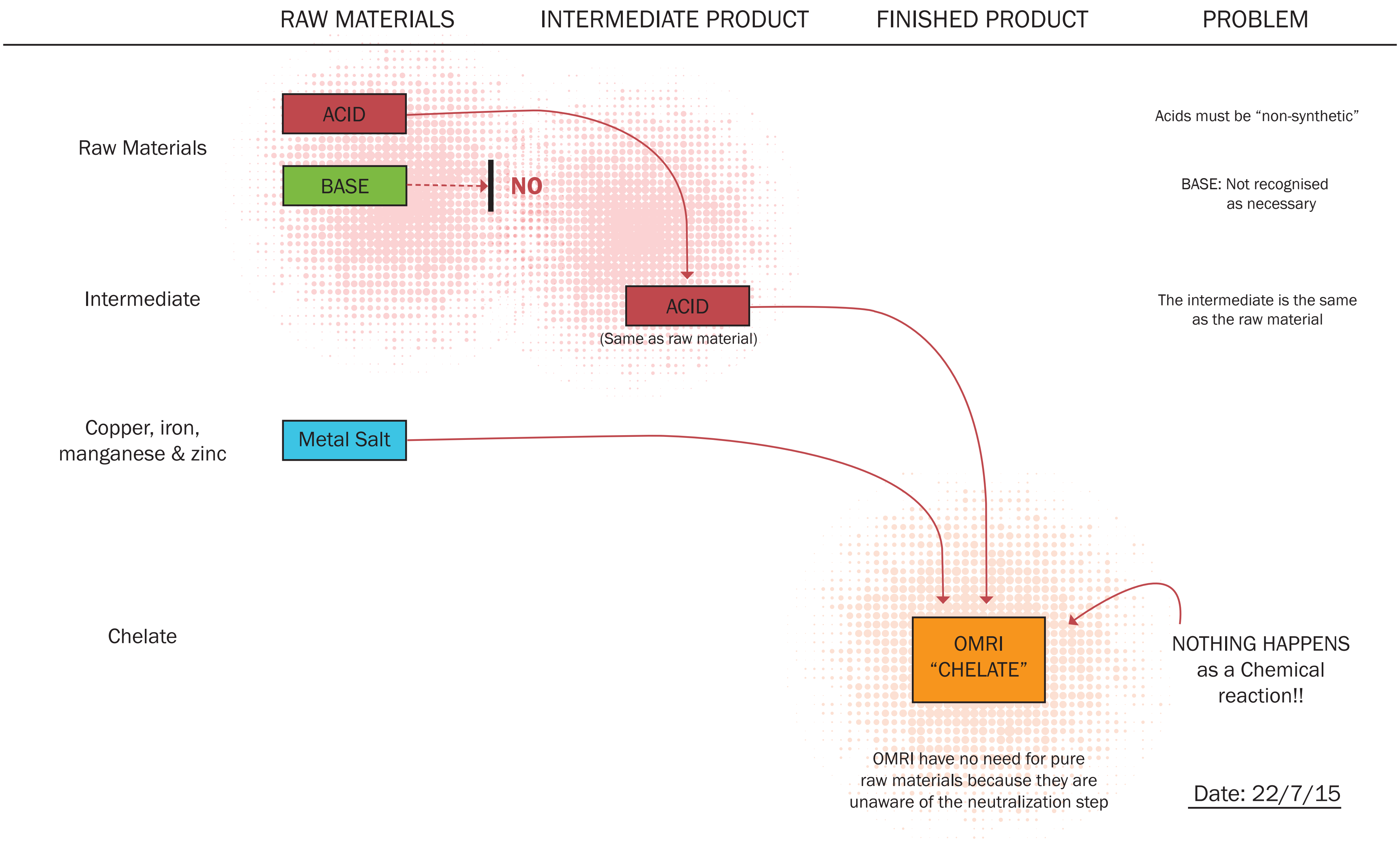
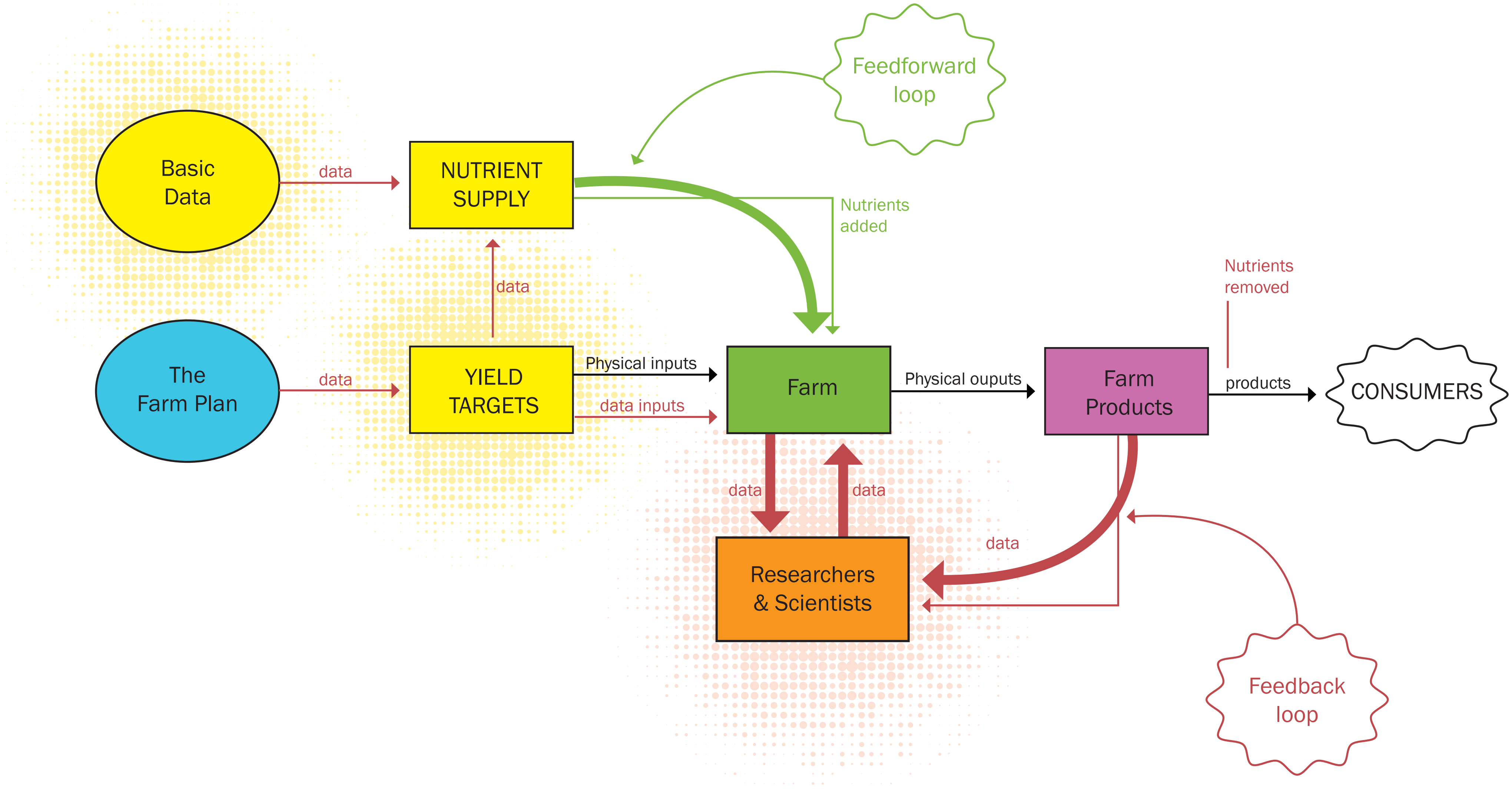


Diagram 4: Sustainable organic-certified agriculture



- Planned farming underpinned by Researchers & Scientists.. and data.
- Controlled farming via prepositioning or replenishing nutrients.

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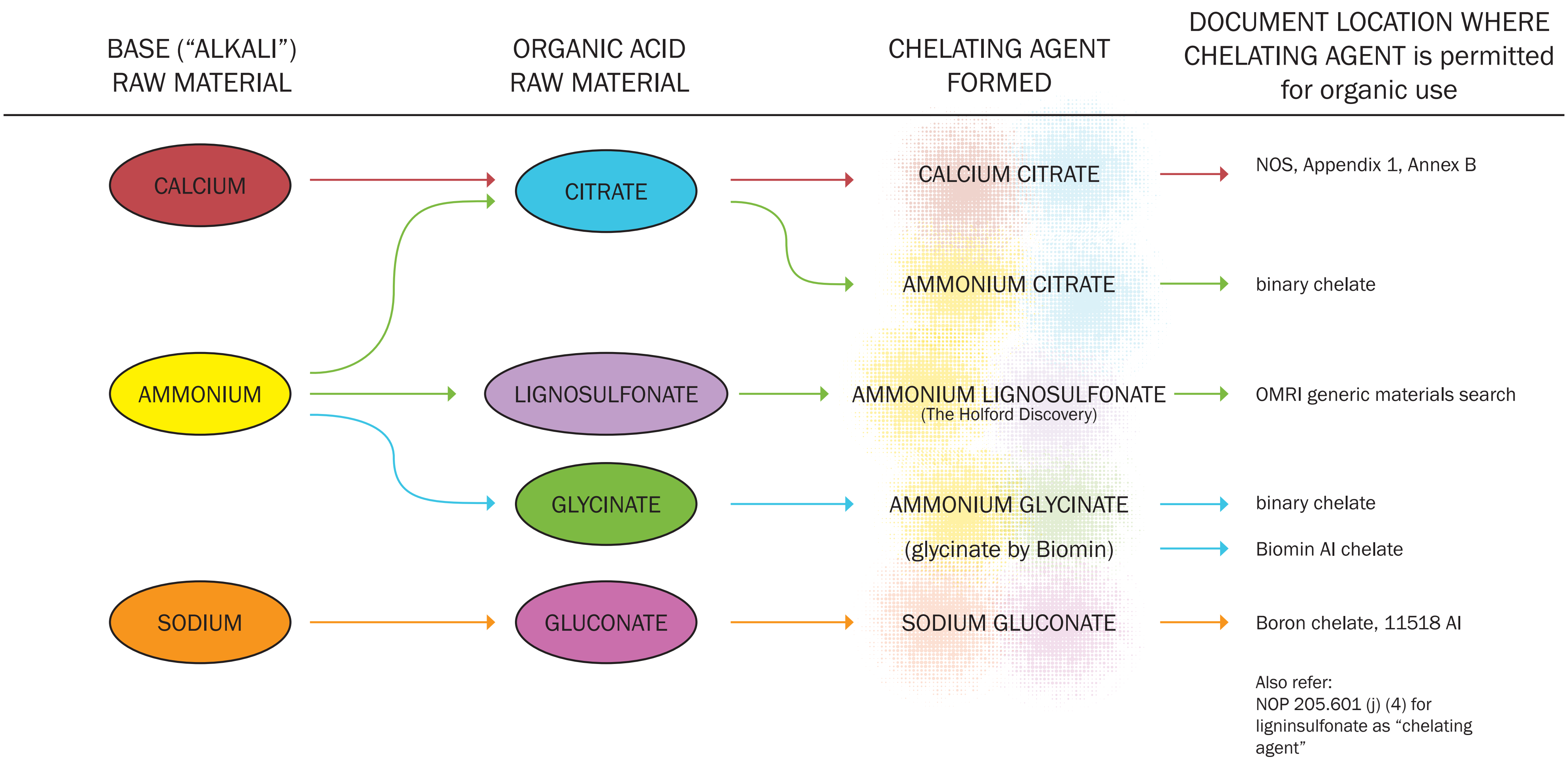
Diagram 6: Organic-certification for a Family of Substances called Chelating Agents

- Organic acids cannot form chelating agents
- Only NEUTRALISED organic acids can form chelating agents



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