Use of biological products in Australian vegetable production

with focus on soil biology

Pieter Van Nieuwenhuyse (AHR)

Use of biologicals in Aussie veggie production

- **Definition and scope**
- **What's out there? Types & functions**
- **Evaluating biologicals: how to pick your champions**
- **Best bet strategy to make your biologicals work**

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- Biological products (or in short biologicals) are products derived from **living organisms** (i.e. plants, animals, microorganisms…). (*according to www.croplife.org*)

- A biological chemical product is an agricultural chemical product where the active constituent comprises or is derived from a **living organism** (plant, animal, micro-organism, etc.), with or without modification. (*definition derived from https://apvma.gov.au/node/11196*)

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Umbrella term for a wide range of product types, which comprise a growing segment of horticultural inputs:

- tendency towards use of more **“natural” products**, considered **more sustainable** and **environmentally logic**
- **cost reduction**: desire to reduce the input of expensive synthetic products
- some synthetics alleged to have negative impact on **soil & aboveground biology**
- pesticides: broad spectrum, environmental persistent chemicals being **withdrawn from market**, **resistance build-up** in many pathogen populations ➔ need for (selective) alternatives.
- Most biologicals/biopesticides have no **re-entry limits**, no **harvest withholding periods** to worry about and no **residues** (MRL).

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Remarks:

- "biological" versus certified organic: is not an **official certification**

Australian Certified Organic

NASAA CERTIFIED ORGANIC

NASAA CERTIFIED ORGANIC

NASAA CERTIFIED ORGANIC A000000

- **A bit of a jungle**: no regulating body in Australia for all biologicals - biological products are not necessarily **meeting their claims** (e.g. stimulating soil biology, boosting plant defence and growth, soil ameliorant…).

  Exception: biopesticides, products containing plant hormones

- **Biomimicry**: many synthetic products are based on biological originals (e.g. pyrethrins, strobilurins)

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Types:

- Biological chemicals: substances derived from living organisms (amino acids, vitamins, enzymes…)
- Microbials: bacteria, micro-algae, protozoans, fungi, viruses, *microscopic nematodes*
- Seaweed extracts
- Fish extracts
- Plant extracts including oils extracted from seed or other plant parts
- Macro-invertebrates
- Blends of different types
- Grey zone: humic/fulvic acids, blends of biological and synthetic compounds

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Functions (Use):

- **Biopesticides:**
  - control of **pests**, **diseases** and **weeds**
  - **APVMA registration**:
    * "biological crop protection products", except macro-invertebrates
    * data on **efficacy**, phytotoxicity, ecotoxicology and residues, formulation
    * **time consuming** + **expensive** ➔ for small crops not worth the investment
  - **Example: Biofungicides for controlling soil-borne diseases**
    * Modes of action: **competition**, **antagonism** (antibiotics), **parasitism, ISR**
    * Types: mainly **microbial** (bacterial: *Bacillus amyloliquefaciens, Streptomyces lydicus*
      fungal: *Aureobasidium pullulans*, *Coniothyrium minitans*)
    * Remark: many biofungicides are **not registered** and are sold as plant growth stimulating products (e.g. *Trichoderma harzianum*) + **next-generation products** in pipeline

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Functions (Use):

- **Biostimulants (Plant growth stimulating products)/Plant defence enhancing products :**
  - Alleged stimulation of soil biology and plant growth/defence
  - **APVMA registration**:
    * not required
    * no data on **efficacy**, phytotoxicity, ecotoxicology and residues
    * **low threshold to commercialise** ➔ many products on market ➔ hard to assess efficacy
  - **Modes of action**: symbiosis, induced systemic resistance (ISR), competition, …

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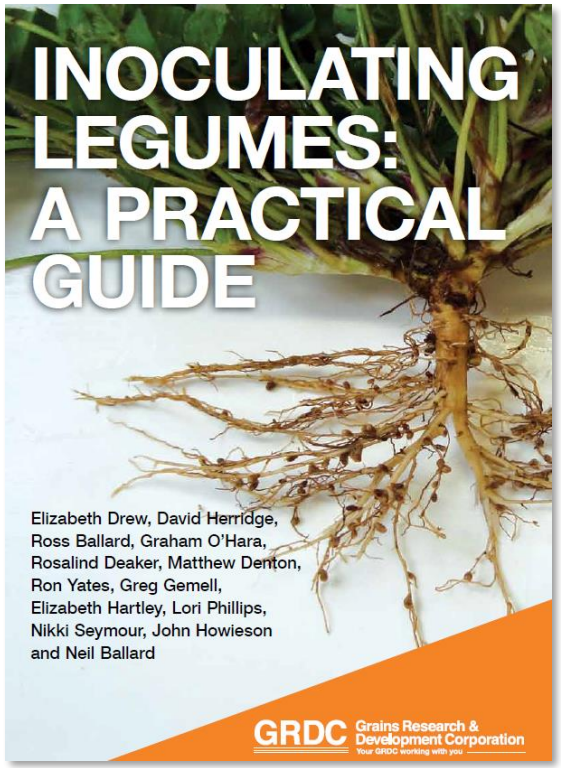
Functions (Use):

- **Biostimulants example: Bacterial inoculants for nitrogen fixation**
  - What?
    - * **Facultative symbiosis** – root colonisation by bacteria (rhizobia) stimulation of **root nodulation – *natural nitrogen fertilizer!***
    - * Matching crops: various strains of rhizobia
  - Use:
    - * All **legume** plants (incl. cover crops!)
      - ⇔ still debate for **non-legume** plants (e.g. *Azospirillum* spp., *Azotobacter* spp.)
    - * Different formulations; only a few manufacturers/suppliers
  - Quality control – #cfu guaranteed



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Functions (Use):

- **Biostimulants/plant defence enhancer example: Mycorrhizal inoculants**
  - What?

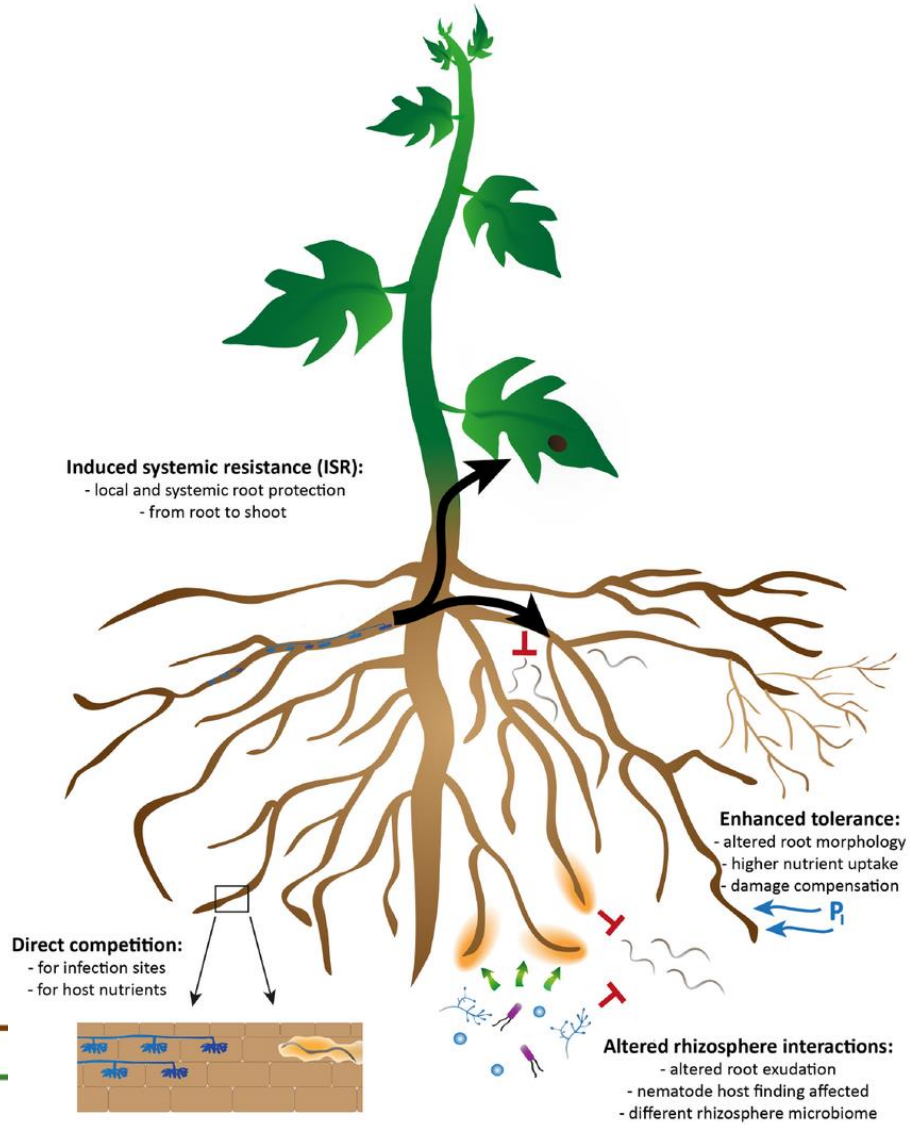
    * **Obligate symbiosis** – root colonisation by beneficial fungi (vesicular arbuscular mycorrhizae, VAM)

    * Enhance **plant defence** (incl. ISR), uptake of (immobile) **nutrients** (e.g. P, Zn), **soil aggregation** (glomalin) & **soil moisture** management + reduce **transplant shock**…
  - Use:

    * Various hosts, not all crops match:

    High: *Apiaceae* (e.g. carrot)/*Amaryllidaceae* (e.g. onion, leek)/legumes
    Moderate: *Solanaceae* (e.g. capsicum, potato)
    None: brassicas/*Amaranthaceae* (e.g. spinach, beetroot)

    * Forest versus agricultural environment: **disturbance challenges**! (tillage, fumigation, crop rotations, OM…)



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For a non-exhaustive list of biologicals available in Australia, visit our biological products database:

https://www.soilwealth.com.au/resources/global-scan-and-reviews/biological-products-database/

BIOLOGICAL PRODUCTS DATABASE - BY APVMA REGISTRATION, TYPE, TRADE NAME

About this database and how to use it - This Biological Product Database is a tool for growers that will assist with navigating the array of 'biological' products currently available to their farming business. We have compiled the information in response to questions from growers about available products.

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General rules of thumb:

- Products containing **live organisms** preferred over extracts of living organisms (but limit the number of different species)
- Be sure the label has a **guaranteed analysis** – Know what you are getting!
- Use **fresh products** – look for those that last 18 months to two years
- Avoid using products that require **refrigeration**
- If label recommends **ongoing applications** – enabling the expression of their many specific and beneficial roles in your crop.

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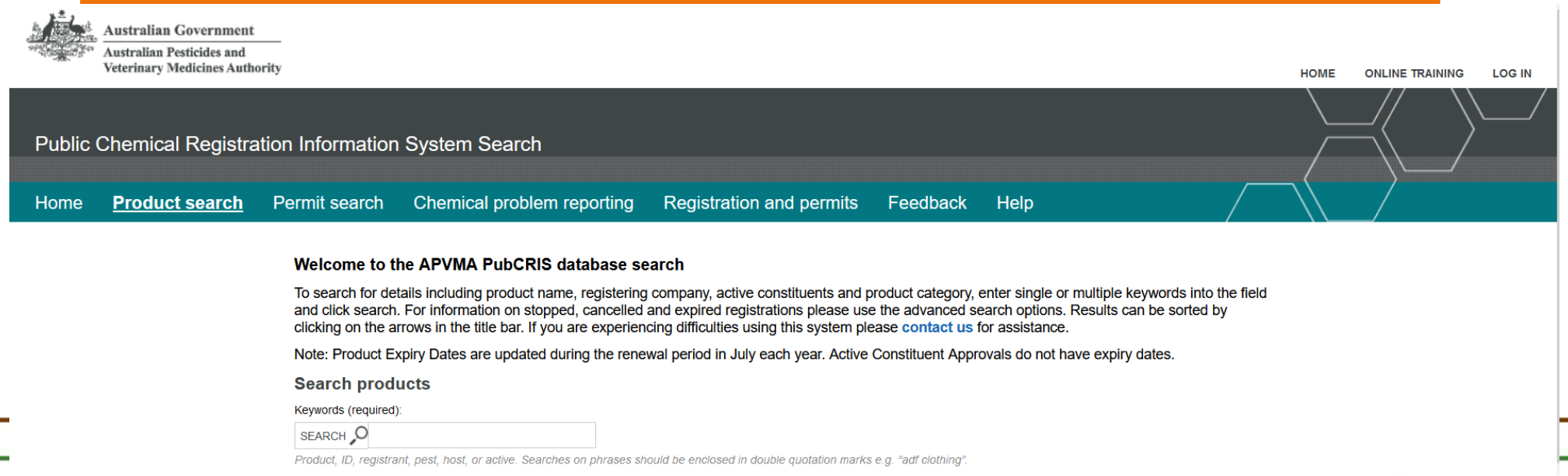
Additional checklist for biopesticides:

- Efficacy guaranteed only for **registered** biopesticides!
- Check **availability of registered** biopesticides first, before considering unregistered biopesticides:

https://portal.apvma.gov.au/pubcris



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Additional checklist for Plant Growth stimulants (Biostimulants)/Plant Defence enhancers – Questions to ask the manufacturer/distributor:

- Supporting **claims**:
  - Availability of any **replicated** field trial/research data?
  - Has any **independent research** been conducted?
  - Are there any **refereed** journal papers?
- Has this product worked **under my local conditions**: similar soil type, crop, climatic conditions
- Any known **adverse crop effects** or **other risks** (climatic conditions, withholding periods, residues, impact on beneficials, PPE needed…)?
- Is there **quality control** and **analysis data** available?

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Integrated approach key to success:

- *Biologicals are the **cherries on the cake**, but the cake needs to be good quality first!*
- Soil **moisture**, soil **pH**, soil **structure**
- **Nutrition** levels
- **Crop rotations**
- **Crop protection:** varietal diversity, biopesticides with different modes of action
- Compatibility with **synthetics** (fertilisers, fungicides, bactericides, fumigants…)
- **Organic matter (OM > 5%; OC > 3%) is your gold**: compost (introduces its own soil biology!), cover crops, reduced tillage

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Do your own research and set up a small scale trial:

- Know the efficacy **before going big**!
- Include an **untreated control** for comparison

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How to monitor change in soil biology:

- Composition of soil biology communities is **highly dynamic**: snapshot (micro)biological tests don't give the full picture
- **Use indicator variables:**

  - Soil structure: Water infiltration, aggregate size & stability, penetration resistance, dispersion, bulk density, soil texture
  - Nutrition availability (standard nutrition soil test)
  - Pressure of soil-borne disease and pests
  - …

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Thanks for your attention!