Biofumigation

Integrated Crop Protection
PROTECTING CROPS

SoilWealth
NURTURING CROPS

Biofumigation is the use of specialised cover crops, which are grown, mulched and incorporated into the soil prior to cropping. High biomass, especially roots, can provide the traditional benefits of green manure crops, and if done right, naturally occurring compounds from the biofumigant plants can suppress soil-borne pests, diseases and weeds.

Common biofumigant crops

In Australia, some commonly used biofumigant crops include:

- Caliente 199™ (mustard)
- Fumig8tor™ (sorghum)
- Nemat™ (arugula)
- Nemclear™ (mustard)

Benefits

Biofumigation crops in your farm's rotation can improve overall efficiency and productivity.

The benefits of correctly incorporating biofumigant crops include improvements in soil health and a reduction in farm inputs. In order to reap the full rewards of biofumigation, certain crop management and incorporation techniques must be used. Benefits are dependent on local climate and soil conditions, the type of biofumigant crop used and its management.

Soil biology

Biofumigation crops act as break crops, disrupting the lifecycle of pests and diseases. Suppression may result from direct biocidal toxicity as well as indirectly through changes in the soil fauna and microbial community. Populations of beneficial microorganisms, including mycorrhizal fungi, have been found to increase after biofumigant crops.

Weed suppression

Early vigorous growth and improved plant vigour help to outcompete weeds. When incorporated correctly, the release of isothiocyanates (ITCs) from the biofumigant crop leads to the biocidal burning of weed seedlings.

Soil organic matter

Organic matter is replenished in the soil after incorporation of the biofumigant. As microorganisms break down organic matter they produce sticky substances that bind soil particles together into soil aggregates. This, in turn improves:

- Water infiltration, water and air holding capacity.
- Structural stability, reducing the risk of compaction.
- Soil friability, making the soil easier to work .
- The soil's resilience to wind and water erosion.
- Nutrient holding capacity.
- Overall biological activity.
- Root growth.

Organic matter also buffers against changes in pH, salinity or sodicity and it inactivates or filters toxic elements.

Nutrient cycling

Deep-rooted break crops can access nutrients stored deeper within the soil profile that are unavailable to

Quick facts

- Glucosinolates (GSLs) or cyanogenic glucosides are responsible for the fumigation effect, and are found in brassicas or specialised sorghums.
- When the biofumigation crop is macerated, GSLs are broken down by the enzyme myrosinase and isothiocyanates (ITCs) are produced immediately.
- ITCs are highly toxic compounds to many soil-borne pests, diseases and weed seedlings.
- To contain ITCs in the soil, the biofumigation crop must be finely macerated, incorporated directly, and the soil surface sealed through irrigation, rain or rolling.

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Biofumigation

shallow-rooted crops. Better biological activity can lead to improved nutrient cycling and crop nutrient uptake. The nutrients become available to the next cash crop. Increased rates of nitrogen mineralisation following brassica and other break crops have been recorded.

Managing a biofumigant crop

Growing a biofumigation crop requires good management and attention to detail similar to a vegetable crop. Unlike many of the low input, low management green manure crops, biofumigation crops may need some fertiliser and irrigation.

To get the most out of biofumigant crops you need to:

- Choose the right variety. There are several varieties available, each with specific requirements and benefits.
- Have the necessary equipment to manage the crop correctly.
- Plant at the best time within your rotation.
- Test soils to ensure appropriate nutrient management for the biofumigant crop as well as subsequent crops in your rotation. Make sure sulphur levels are adequate.
- Time biofumigant crop growth to maximise ITC production. GSL levels are highest at mid flowering.
- Seed at the rate recommended by the seed supplier to get the most benefit.
- Macerate and incorporate. These should only be done when soil moisture levels are not too high, otherwise soil structure will be damaged.
- Incorporate the well-macerated biofumigant straight away to releae the ITCs. Soil temperatures >12 degrees improve ITC formation.

Benefits of biofumigants will not always occur after the first crop.

Biofumigants cannot be grazed.

All agronomy management practices should be discussed with your production advisor.

More information

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Case study: Manjimup, WA

David East, a lettuce grower from the Manjimup region, WA, became hooked on the benefits of biofumigation during his long participation in the WA Department of Agriculture's brassica projects.

He uses biofumigants (caliente mustard) and other green crops extensively on his three properties growing direct-seeded iceberg, cos and babyleaf lettuces.

David is using biofumigants to control Sclerotinia in iceberg and cos as well as weeds in babyleaf. As a further disease break measure, he'll sometimes use perennial pastures for a long rotation. He found that using different green crops helps release phosphorus (P) from his high P fixing soils and improves organic matter levels. He now is involved in the Soil Wealth project to be able to quantify why he's getting big results with caliente mustard and the economic benefits.

David is keen for fresh vegetables to be a highly profitable industry in Manjimup. The aim for him and his three sons is to be the best sustainable producers of high quality summer, autumn and early spring vegetables.

Lettuce after biofumigation.

Lettuce without biofumigation affected by Sclerotinia.

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