



# *Caliente Mustard Blends*

*Improving the Health of  
Agricultural Soils*





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## Caliente Mustards

Caliente Mustards have been bred specifically for biofumigation and green manuring. The naturally occurring biofumigant gas (ITC) is produced by the plants when the crop is chopped, incorporating this compound and the green material into soil results in many benefits including improved soil structure, health and fertility, suppression of various soil-borne diseases and pests and increased soil microbial activity.



### Benefits of green manuring:

1. Improves soil fertility and structure
2. Adds nutrients and organic matter
3. Improves soil aeration
4. Increases water infiltration and holding capacity
5. Reduced soil erosion from wind and water
6. Increases soil biodiversity by stimulating the growth of beneficial microbes and other soil organisms
7. Ideal for organic crop rotations and conventional systems where ICM (Integrated Crop Management) and reduced risk inputs are favoured

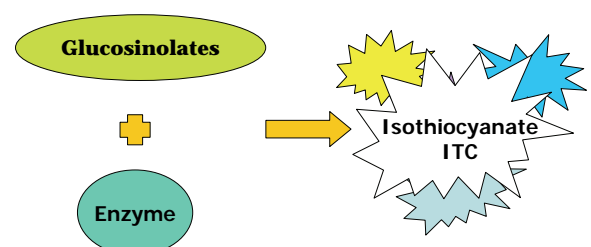
### What is biofumigation?

Biofumigation refers to the suppression of various soil borne pests and diseases by naturally occurring compounds. Caliente Mustard produces isothiocyanate (ITC) a natural gas released from all brassicaceous plant tissues. The gas is produced when plant cells are damaged (by crushing or chopping) and compounds called glucosinolates (present in all brassicas) come into contact with an enzyme (myrosinase) in the presence of water.

It is believed that this mechanism was originally developed by the plant as a defence against sucking and chewing insects, but over time many of the glucosinolates (the compounds that make certain brassicas 'hot' e.g. radishes) have been bred out of brassica crops to make them more palatable for human and animal consumption e.g. cabbage and cauliflower, or to produce better quality oil e.g. oil seed rape.

To create the best biofumigation effect, Caliente Mustard plants must be chopped as finely as possible before immediately incorporating into soil, simply ploughing in the crop will not give the same effect. The following diagram simplifies the chemical reaction that takes place in a plant cell during biofumigation.

### 3. Biofumigation





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## How is Caliente Mustard different?

Caliente Mustards are bred specifically for biofumigation, they contain very high levels of the correct glucosinolates (there are many different types, and some do not produce lots of ITC), and high levels of the myrosinase enzyme, in addition they have the potential to grow into large plants producing high levels of biomass and therefore more green tissue to produce ITC when chopped.



Healthy Stands Compete With Weeds

soil which encourages beneficial microbe multiplication. These beneficial soil microbes play an important part in 'out-competing' pathogenic microbes for space in the soil profile, helping to keep soil disease levels down.

Caliente Mustards have been developed over many years, with new blends and varieties developed for performing specific functions, and for growing in different climates and situations. They are not simple green manure or cover crops and should not be confused with fodder mustard which is commonly available as a green manure and will not generate the same biofumigation effect.

When considering disease suppression, it is important to note that the biofumigation aspect is not the only important factor. It is a combination of the biofumigation plus the incorporation of green material into the

### Growing the Crop

Successful biofumigation and green manuring from Caliente Brand Mustards requires a number of inputs, which will be repaid in following crops. Failure to treat Caliente Brand Mustards as a 'crop' may result in disappointment.

### Seed placement

A reasonable seed bed is required, maximum seeding depth 5-10 mm. Seed should be shallow drilled and rolled, or broadcast (shallow harrowed) and rolled. Seed can be broadcast into cereal stubbles, rolling will improve germination. Fixed beds - reduce seeding rate/ha to take account for wheel tracks.

### Timing

Crops grown on non-irrigated land should be timed to coincide with normal weather patterns. Crops will respond to irrigation during dry periods. Summer sown crops will respond well to irrigation throughout all crop stages to supplement rainfall. Overwintering of crops is possible.



### Irrigation

Soil moisture is essential at sowing and to establish the crop; lack of water will lead to premature flowering and reduced biomass production. The biofumigation reaction will only occur in the presence of moisture. Where irrigation is available, ensure crop is watered throughout germination and establishment, and as required to keep soil moist.



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## Fertilizer

For maximum biomass production Caliente Brand Mustard crops require 120-140 kg/ha nitrogen, depending on soil type and previous cropping. Up to 90% of this nitrogen will be recycled and made available to following crops. Apply entire quantity of N at or immediately after sowing, except for overwintered crops where applications should be split into two; at sowing, and once growth restarts in early spring.

Sulphur levels vary greatly by soil and geography, but as a guide Caliente Brand Mustard crops require S in a ratio of 1:5 with N, for maximum glucosinolate production.

Organic growers may experience reduced biomass due to restricted fertilizer inputs, however good crops can still be achieved on fertile soil.



## Incorporation

Time to crop maturity will vary with time of year and climatic conditions, but generally ranges from 60-100 days for a spring to late summer sown crop. Overwintered crops will take significantly longer. At maturity vertical growth will stop, and if grown to full potential will achieve a height of approx 100-150 cm, producing 50-100 t/ha biomass (fresh weight), of which 15-20% constitutes dry matter. Aim to incorporate crop up to 2 weeks after first bloom for maximum biofumigation effect.

Chop the crop using a flail mower with hammer blades for maximum cell destruction, immediately followed by cultivation equipment to incorporate to a depth no greater than 15cm, producing a fine tilth and rolled to seal the surface, trapping the ITC gas.

In 20 minutes 80% of the ITC gas will be lost – it is therefore essential to incorporate the crop as quickly as possible after chopping. Use two pieces of equipment that closely follow each other, or large machinery that allows for one pass. Soil moisture at incorporation is essential for biofumigation, either irrigate or incorporate after rain.



## Post Incorporation

Leave for 14 days after incorporation before planting subsequent crops. Crops grown as soon as possible after 14 day period will gain greatest benefit from green manure and biofumigation.

Avoid ploughing and excessive cultivation before the following crop, subsequent cultivations should remain within the incorporated depth. All varieties are soft seeded and should not pose a volunteer problem providing seed is not allowed to ripen.

As a guide, after first bloom, seed ripening takes 28-42 days. Any ripened seeds that do self-sow will germinate in one flush, enabling easy control by mechanical or chemical methods.



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## CALIENTE BRAND MUSTARD PRODUCTS AVAILABLE FROM SEED AND FIELD SERVICES LTD.

- **Caliente Brand Mustard 199**

Produces excellent biomass with the highest “biofumigation” potential available. Contains ISCI 99, with the highest glucosinolate level of any commercial variety. Excellent disease, weed and nematode suppression in many crops. Responds to good fertility and management. Seeding rate 10-12 kg/ha

- **Nemat/Caliente 199**

ARUGULA MUSTARD BLEND – Arugula /mustard blend that was designed for high biomass production and improved nematode suppression, especially in IPM programs combined with chemical nematicides. Shows excellent disease and weed suppression also. Seeding rate 7-8kg/ha



## What are the benefits of Caliente Mustard?

There are a number of benefits common to all crop types, soil types, climate and situation:

1. Improvements to soil structure, fertility and biodiversity from the green manure effect
2. Provides a good source of nutrition to following crops, recycling nutrients like nitrogen
3. Encourages improved root systems and penetration (of following crop)
4. Measurable yield increases in following crops
5. Weed suppression, mainly of soft seeded annuals, most beneficial to crops following soon after Caliente Mustard incorporation

### Benefits to potato and root crops:

1. Suppression of a range of soil-borne diseases, including Verticillium wilt, Rhizoctonia spp., Pythium spp., Fusarium spp., and Sclerotinia spp.
2. Suppression of a range of nematodes (eelworms) including some cyst, root knot and free living species. Trials are ongoing to determine the effectiveness of Caliente Mustard against Potato Cyst Nematode (eelworm) specifically
3. May improve skin finish
4. May deter wireworm populations

### Benefits to vegetable and salad crops:

1. Suppression of a range of soil-borne diseases including Pythium spp., Sclerotinia spp., Fusarium spp., Rhizoctonia spp., and others
2. Suppression of a range of nematode species
3. Offers significant reduction in weeding costs, in terms of subsequent herbicide applications, and/or labour for hand/mechanical weeding. This is a particularly important benefit for organic systems



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