

Caliente Brand Mustard

For green manure and biofumigation



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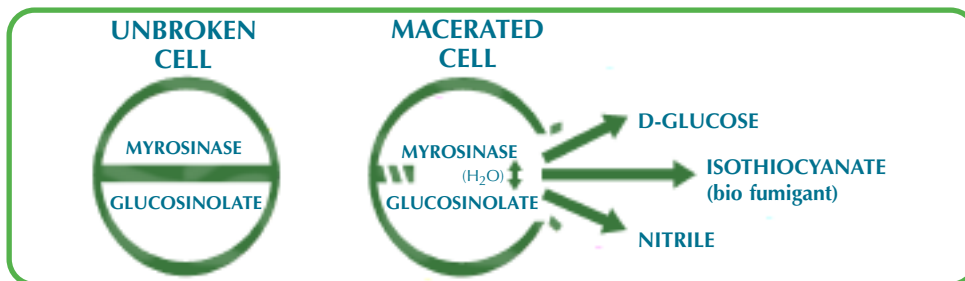
Why Green Manure?

The incorporation of green plant tissue into the soil is an ancient practice known as 'green manuring'. As well as being an economical and practical method of restoring productivity to idle or overworked land, Caliente Brand Mustard green manures have additional advantages:

- Improves soil fertility and structure.
- Adds nutrients and organic matter.
- Improves soil aeration.
- Increases water infiltration and holding capacity.
- Reduces soil erosion from wind and water.
- Increases soil biodiversity by stimulating the growth of beneficial microbes and other soil organisms.
- Ideal for use in organic crop rotations and in conventional systems where ICM and reduced risk inputs are favoured.
- Measurable yield increases in following crops.

The Biofumigation Process

Biofumigation refers to the suppression of soil borne pests and pathogens by naturally occurring compounds, predominantly isothiocyanate (ITC) released from Brassicaceous plant tissues. When these plant tissues are damaged, glucosinolates and a particular enzyme (Myrosinase) present in plant cells are allowed to come together, and in the presence of water produce ITC.



Caliente Brand Mustards and Nemat are not simple green manure crops. They are bred and selected by ISCI, Bologna, Italy, to produce large quantities of biomass, and contain high levels of the specific desirable glucosinolates and enzymes that are required for the biofumigation process. All our varieties are protected by plant breeders' rights.



Chopping Caliente Brand Mustard



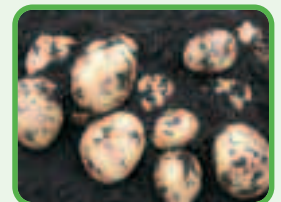
Incorporating Caliente Brand Mustard

Benefits to Potato and Root Crops

- Improvements to soil health from green manure effect.
- May improve skin finish on potatoes and deter wireworm populations.

Suppression of:

- Weeds.
- Range of nematodes (including cyst, root knot and free living species).
- Range of soil-borne pathogens (including *Verticillium dahliae*, *Rhizoctonia* spp., *Pythium* spp., *Fusarium* spp., and *Sclerotinia* spp.).



Benefits to Soft and Cane Fruit Crops

- Improvements to soil health from green manure effect.
- Provides a good source of nutrients to following crop, particularly nitrogen.
- Encourages improved root system and penetration.

Suppression of:

- Weeds.
- Range of soil-borne pathogens (including *Verticillium dahliae*, *Fusarium* spp., and others).
- Range of nematode species.



Benefits to Vegetable and Salad Crops

- Improvements to soil health from green manure effect.
- Provides a good source of nutrients to following crop, particularly nitrogen.

Suppression of:

- Weeds.
- Range of soil-borne pathogens (including *Pythium* spp., *Sclerotinia* spp., *Fusarium* spp., *Rhizoctonia* spp., and others).
- Range of nematode species.

Offers significant reduction in weeding costs, in terms of subsequent herbicide applications, and/or labour for hand/mechanical weeding. A particularly important benefit for organic systems.



Other Applications

Caliente Brand Mustards and Nemat are suitable for a wide range of other applications, including:

- Before replanting top fruit.
- Forestry and tree production.
- Protected cropping (soil grown).
- Ornamentals and hardy nursery stock.
- Cut flower production.
- Bulb production.
- Viticulture (wine and table grapes).

Caliente Brand Mustard Products

There are a range of varieties available to suit different climatic conditions, crop pests and cropping programmes.

Caliente Brand Mustard 119

Two blends are now available:

119 NR - for late summer and early autumn sowing only (UK).

119 R - for spring, early summer and late autumn sowing (UK).

Excellent all round variety with a proven track record for all cropping areas.

Developed for the US potato market over 13 years ago, now with several years experience in the UK under various cropping conditions.

Best variety for organic systems.

Recommended seeding rate: 15 kg/ha.

Caliente Brand Mustard 99

Hottest variety, giving the best biofumigant action due to very high levels of glucosinolates (30% more than variety 119)

Requires good growing conditions.

Fertiliser inputs and irrigation are essential to get the best from this variety. Recommended seeding rate: 10 kg/ha.

Caliente Brand Mustard 61

Large leaved variety producing high levels of biomass.

Longer season and slowest to flower out of all mustard varieties.

Temperature sensitive, requires warmth.

Suitable for mid-summer sowings (UK).

Best variety for warmer climates (e.g. Spain, Portugal).

Requires irrigation where soil moisture is low.

Recommended seeding rate: 8 kg/ha.

Nemat (*Eruca sativa*)

Trap crop for various nematodes, including some root knot and cyst species.

Plant roots contain highest levels of glucosinolates.

Dense foliage produces good biomass, although crop is shorter in height than mustard varieties.

Mowing crop before flowering can extend growing season and increase nematode trapping time.

Tolerant to a range of high and low temperatures, frost tolerant.

Relatively drought resistant once established.

White flowered.

Recommended seeding rate: 8 kg/ha.



Caliente Brand Mustard grown under polythene tunnels



Flowering Caliente Brand Mustard



Caliente Brand Mustard grown on fixed beds

The ability of Caliente Brand Mustards to reduce pest pressure and improve soil quality will vary with soil type, management technique, production timing and existing pest pressure. We recommend that growers evaluate their own situation before relying solely on these products for pest control.

Crop Protocol

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 wheelings.

Timing

Crops grown on non-irrigated land should be timed to coincide with normal weather patterns, sow early or late in the year (UK) to take advantage of residual soil moisture, although crops will respond to irrigation during dry periods. Summer sown crops (May, June, and July in UK) will require irrigation throughout all crop stages to supplement rainfall.

Overwintering of crops is possible, especially in south UK and warmer climates. Successful crops must be sown late, no earlier than early-mid October (UK) depending on conditions.

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 water. Where irrigation is available, ensure crop is watered throughout germination and establishment, and as required to keep soil moist.

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.

Beds can be formed at incorporation if required, and polythene laid if necessary for the following crop.

Post Incorporation

Leave for 14 days, and ideally perform a cress test before drilling or planting subsequent crop.

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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Plant Solutions is a division of Tozer Seeds Ltd

