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CLEANSTART™
Basamid

Basamid in practice for lettuce and leafy salads

Application Guide

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Index

Page

10. Rules and Regulations

Dazomet is the only authorised soil fumigant under Annex 1 of Directive 91/414/EEC and will be Annex 1 included until **31/12/2021**. Basamid has been the key soil fumigant for a number of growers in high value, speciality crops in both field and glasshouse situations. From **1st December 2011** treatments can only be allowed to be made to the same area **once every three years**.

◈ Rates of Use

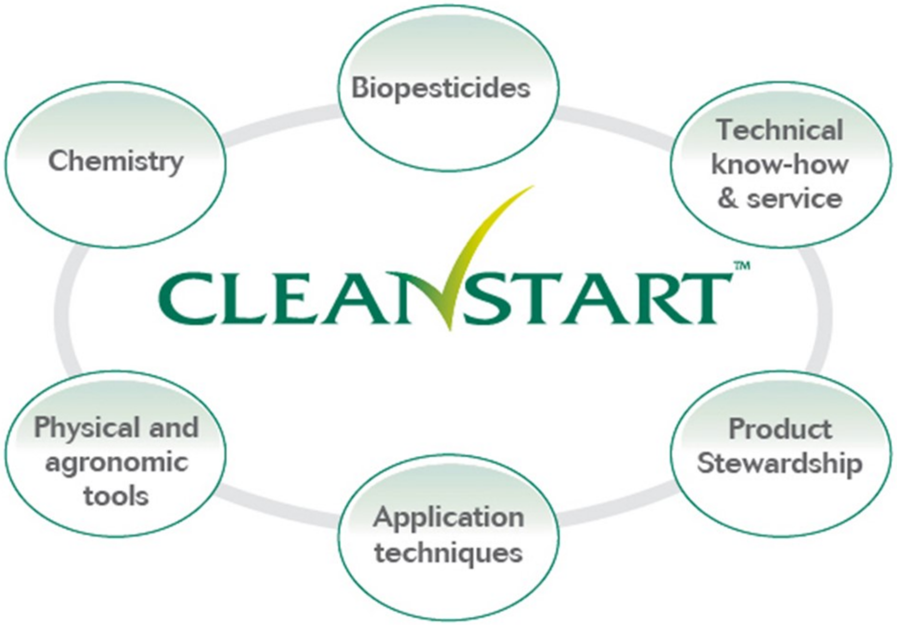
RECOMMENDATIONS*	RATE	INCORPORATION DEPTH
OUTDOORS	220 kg/ha (22 g/m²) to 570kg/ha (57g/m²)	15 to 25cm
UNDER GLASS OR TUNNELS	380 kg/ha (38 g/m²) to 760kg/ha (76g/m²)	20-25 cm

**For full information on soil types and targets check with product label and product approval.*

◈ Safety test

Half fill six jam jars with soil from the treated area taken at random from 15 cm below the surface. For larger areas more samples are required. A minimum of six per 250 m² is recommended.

As a comparison include a jar half filled with untreated soil from an adjacent area. Sow cress seed on to the soil surface, ensuring sufficient moisture is present for germination to take place, thoroughly seal the jars and leave for 48 hours in a warm room when the cress should germinate normally. If there is any delay or growth check, wait for another 7 days and repeat the cress test until germination is satisfactory. Re-cultivation will help to encourage dispersal of any remaining sterilising gas in the soil (this cannot be done where polythene seal is retained - see Specific Recommendations, Section 2.4). Sowing or planting of the crop may follow immediately the safety test is clear.



1. Introduction

Soil sterilisation is used in lettuce production because it offers the best effective control of weeds and the bottom rot disease complex. Herbicides and fungicides can control them but they are not always as effective and the range of products available is constantly decreasing.

Sterilisation has meant that growers are able to do a single treatment that can last for several crops. With some crops little or no extra chemical control will be required for both weeds and diseases. For other crops, pesticide inputs will be reduced and consequent residues will therefore be minimised.

Basamid being applied in a glasshouse

Following sterilisation there is also the additional benefit of quicker, more uniform growth, leading to improved quality, reducing percentage grade out and making the planning of harvest easier.

With protocols now requiring effective residue reduction strategies, sterilisation with **Basamid** is a practical option for growers as it provides a reliable growth medium, with the added confidence that it leaves no residues in the crop.

9. Aeration time and germination test

The aeration time is dependent upon the soil temperature and the water content of the soil. If there is adequate moisture during the sterilisation process then aeration should be as shown in the graph above.

The more the soil is loosened for aeration, the quicker the following crop can be planted

To ensure that all the sterilant gas has been released a germination test (Cress Test) should be performed. This involves:

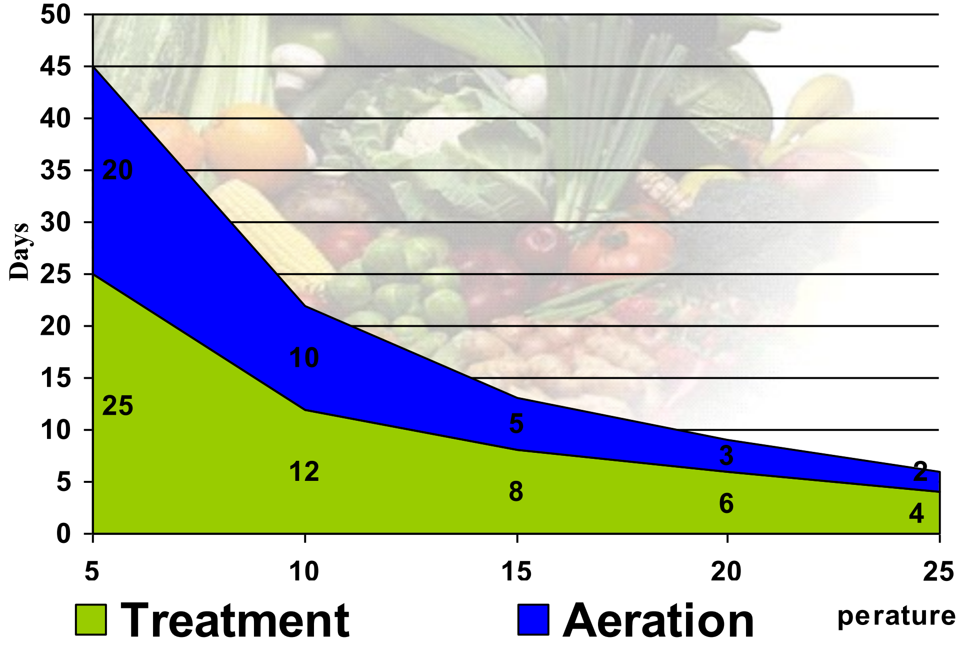
- Taking some soil from the treated area and placing it into an airtight container.
- Moist cotton wool should then be suspended above the soil in the jar with some cress seed sprinkled onto it.
- A second jar should be prepared in exactly the same way but the soil should come from an untreated area. (This acts as a control so that any differences in germination can be observed).
- The jars should be kept at about $20^{o}C$ to get fast germination. (Cress seeds do not have to be used, lettuce seed could be used instead).
- If the cress in both samples germinate at the same time then it is safe to plant. If the Basamid treated soil slows germination of the cress compared to the untreated or kills the cress, then this is an indication that the soil is not ready to be planted.

The soil used for the test should be taken from throughout the treated soil profile and not just from the soil surface, where aeration is greatest.

Failure to do this may give a misleading result.

8. Post-treatment

After **Basamid** has been incorporated and the soil surface sealed, the sterilisation process takes place. The temperature of the soil at incorporation will determine the length of time this will take. This is shown in the graph below.

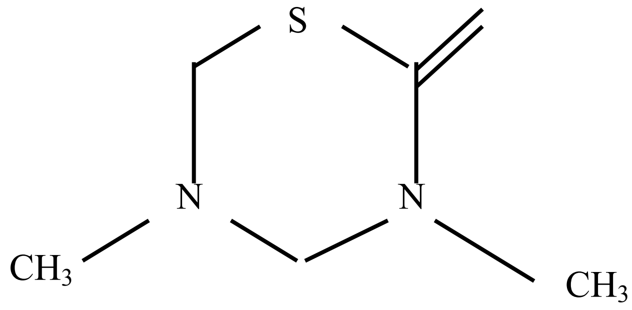


TOP TIP

It is now believed that running through the soil with a straight tined harrow (to a depth not deeper than the **Basamid** incorporation depth) will loosen the soil adequately to allow for effective aeration to take place.

2. Basamid and its properties

The active ingredient in **Basamid** is dazomet. In contact with moist soil, dazomet releases methyl-isothiocyanate (MITC) along with other sterilising gases. However it is mainly MITC that acts as the soil sterilant.



Chemical structure of dazomet

MITC is a broad-spectrum sterilant controlling a wide range of fungi, weeds and soil pests.

3. Conditions for optimum sterilisation

a) Organisms that are active (i.e. not in a dormant state) will be in the most susceptible physiological state to be controlled.

The physiological states that give greater resistance to sterilisation are:

- Fungi either in large resting spores or sclerotia where the sterilising gas may not be able to penetrate or dormant mycelium in plant tissue
- Weed seeds that have not germinated and have a particularly hard thick seed coat that the gas can not penetrate.

Basamid contains 97% dazomet and is formulated into a micro-granule (prill). **Basamid** prills are very stable, only breaking down in contact with soil moisture.

b) Moisture content of soil

It is contact with soil moisture that breaks down the prills of **Basamid** into MITC. It is therefore critical that there is enough moisture within the soil. If there is insufficient moisture, the concentration of gas released within the soil will be too low and sterilisation will be less effective. In addition a low moisture content may also create another problem as the **Basamid** granules can remain 'dormant' in the soil, only releasing MITC gas once the soil becomes sufficiently moist possibly damaging or killing any crop that may have been planted following treatment.

Excess water can also create problems, as air spaces within the soil become filled so the MITC gas is unable to move around the treated soil profile freely. This will also lead to poor levels of sterilisation. This will not be a problem in higher sand based soils.

b) Smear rolling

This technique smears the soil surface by using a roller moving in the same direction to forward travel, but at a faster speed, which produces a skidding effect and leaves a smear that seals the soil surface trapping the gas in the soil. The soil should then be irrigated as above. Compression rolling can be used but only where shallow soil sterilisation is required.

c) Polythene sheeting or mulch

This is the best way to seal the soil producing the most effective gas impermeable seal. The polythene mulch should be a minimum of 50mm thick and when applied it should be kept in contact with the soil surface. Watering before applying the polythene will help to get the best results. Water applied over the polythene after it is laid down, will help keep it tight to the soil.

Using polythene mulch gives the best results and has the added advantage of warming up the soil prior to planting, thus achieving a quicker sterilisation turn around time.

Smearing can also give good results but the surface must be kept moist and it should be noted that there needs to be enough clay within the soil to produce a

6. Application techniques

Basamid needs to be applied evenly and uniformly over the soil surface prior to incorporation. Poor coverage will lead to uneven mixing and therefore reduced efficacy.

- After application the product needs to be worked into the soil.
- Spading machines have been shown in trials to produce the most even distribution in the soil profile.
- Other rotary cultivators may be used (L shaped tines are effective)
- Machines such as a power harrow are not effective for deep incorporation as they only stir the upper surface of the soil.
  - ⇒ **However, where lower rates of Basamid are being used for surface sterilisation of weeds, this type of cultivation may be sufficient.**
  - ⇒ **Incorporation should occur as soon as possible after application.**

7. Sealing the soil surface

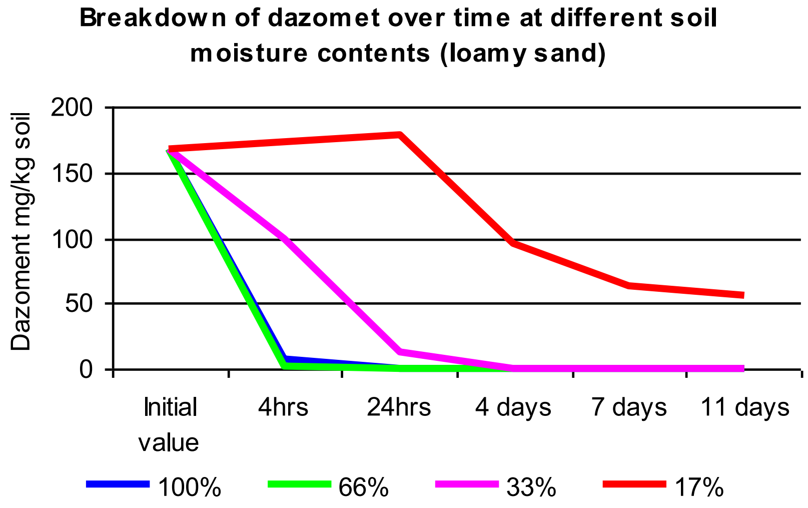
After incorporation, the soil surface needs to be sealed to keep the MITC within the soil profile. Sealing needs to be done relatively quickly, as the release of gas can be very rapid in warm moist soils. There are three principal methods of sealing:

Use Basamid at a rate of 76g/m^2 and incorporate to a depth of 25cm for the control of *Sclerotinia* and *Rhizoctonia* in glasshouse crops. For outdoor crops the rate can be reduced to 57g/m^2.

a) Irrigation of the soil

This should be kept up for 5-7 days after treatment and the soil should not be allowed to dry out. An initial application of 15mm should be given with follow up applications sufficient to maintain a moist surface.

When considering soil moisture content there are a number of measurements that can be made. With **Basamid** it is the **percentage water holding capacity** that is important. A soil at 100% water holding capacity is effectively at field capacity, i.e. the maximum amount of water that can be held in the soil under free drainage.



The above graph shows the speed of breakdown of dazomet as influenced by soil moisture content. **It can be seen that optimum release is at 66% of field holding capacity.**

To get the best results from using Basamid, the moisture content needs to be at a minimum of 40% and the optimum range is between 60 and 70% of the water holding capacity. For sandy and silt soils this should be closer to 70% as these soils are very porous and do not hold water for as long a period as, for example, loamy soils.

c) Soil temperature

Soil temperature affects the release pattern of the sterilising gas. Dazomet will break down more quickly into MITC in higher rather than cooler temperatures. A quick release of the gas is important, as the more gas that is released and held in the soil at any one time allows a higher concentration of MITC leading to more effective sterilisation.

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In order to obtain short treatment times and maintain cropping programmes, it is recommended to treat soils when temperatures are **above 7°C**. Warmer gas also has more energy and is able to move further within the soil profile.

Soil temperatures above 25°C should be avoided as the gas will be released too quickly and will not stay in the soil profile long enough to have sufficient exposure to the target organism, hence the MITC concentration and its exposure time is reduced.

When using **Basamid** at higher temperatures sealing the soil surface becomes an important consideration in order to keep the gas within the soil. At higher temperatures water should be applied to keep the soil moisture close to the optimum rate of 60 – 70% field capacity, especially at the soil surface, as during higher temperatures there will be a rapid drying of the surface. The application of water will also reduce the temperature of the soil.

Temperature also has a large effect upon the physiological state of the target organisms (see 3a page 4); warm moist soils encourage weeds and fungi to break dormancy making them more susceptible to the sterilising gas.

⇒ ***Sclerotinia*** is similar to *Rhizoctonia* in that it does not produce spores, but rather resting bodies of mycelium called **sclerotia**.

- These resting bodies can last for 10 years in the soil.
- *Sclerotinia* can also be spread by water splash to other parts of the crop.
- *Sclerotinia* produces black sclerotia within the leaves and a rotting that makes the crop unsaleable.
- *Sclerotinia* affects the crop through the stem and base leaves where the crop comes into contact with the soil.

Sclerotinia - is another soil inhabiting pathogen. It is an economically important disease of lettuce and can cause huge reductions in yield. It is a pathogen that prefers humid conditions and relatively high temperatures.

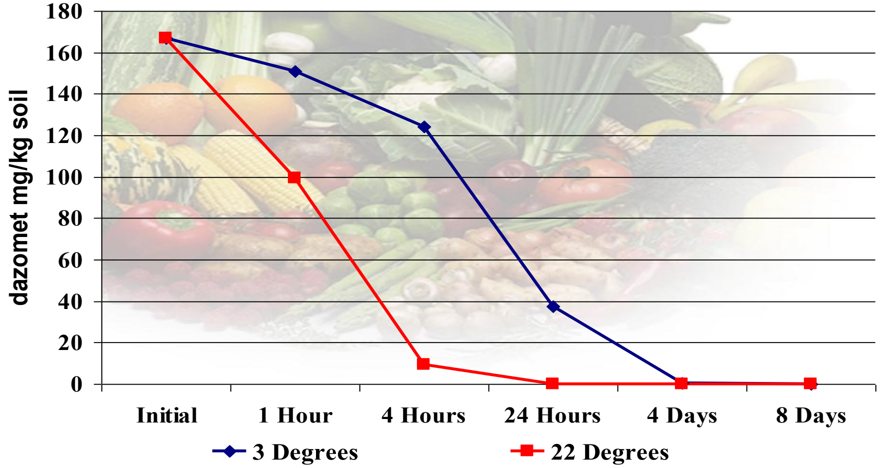
5. Disease control with Basamid

Lettuce is susceptible to many soil-acting pathogens that can have a major effect on crop quality and yield. In glasshouse situations this has become particularly important because of the multiple cropping of a single crop species. The pathogens of lettuce therefore have an ideal environment to colonise an ever-present host.

⇒ ***Rhizoctonia solani*** - an economically important disease in lettuce. High crop losses both in weight and quality can occur because of this pathogen, both early on during production and also later on when cutting and grading the crop.

***Rhizoctonia* on the base leaves of lettuce**

Rhizoctonia is referred to as a 'sterile fungus' as it does not easily produce spores under normal conditions. However it does produce the resting stage known as sclerotia. *Rhizoctonia* is a soil inhabiting fungus therefore infection usually occurs around the stem and lower leaves that come into contact with the soil. *Rhizoctonia* occurs under a number of conditions and so can be an all year round problem. In glasshouse lettuce, it can be a particular risk during the winter months when crop growth is slower.



d) Soil structure

A very friable soil is the ideal condition for an application of **Basamid**. The soil should be worked down to a fine tilth and contain no large clods. A good crumb structure will allow more gas movement around and through the treated soil profile.

Soil type will also have an impact on the rate of **Basamid** that is used. There are two reasons for this:

Density of the soil - clay soils weigh more for a given volume than a sandy soil. Sandy soils are more open and have more air spaces and so are lighter.

Chemical nature of clay soils - they contain more electrically charged particles and therefore have a larger cation exchange capacity (CEC). MITC can bind to these sites and thus reduce the overall concentration of MITC available for sterilisation.

This may also occur with high organic matter soils, or soils that have had large amounts of organic matter added to them. It is therefore important that no extra organic matter such as fertilisers or manures is added to soil that is to be sterilised with **Basamid**.

Soils with high organic matter, e.g. peat soils, generally have a high affinity for holding onto chemicals applied to the soil as the soil binds onto the chemical molecules.

When deciding on the rate of application of **Basamid** the soil composition should be examined and where there are high disease pressures and heavier soils, rates should be increased

4. Weed spectrum

Basamid controls a wide range of weed species. Rates of application are listed below for some common seed species while dormant.

*In the trial where these rates were used **Basamid** was incorporated within the top 20cm (8 inches) of soil.*

Rate of Basamid g/m²	Weed Species
30	*Chenopodium album* (Fat hen), *Galium aparine* (Cleaver)
60	*Avena fatua* (Winter wild oat), *Matricaria spp.* (Camomile), *Senecio vulgaris* (Groundsel), *Chrysanthemum segetatum* (Corn marigold), *Polygonum persicaria* (Persicaria), *Stellaria media* (Chickweed)
76	*Alopecurus myosuroides* (Black grass), *Poa spp.* (Meadow grasses), *Rumex obtusifolius* (Broad leaved dock), *Trifolium spp.* (Clovers), *Datura stamonium* (Thornapple), *Raphanus raphanistrum* (Wild radish), *Sinapis arvensis* (Charlock)

The reason for the difference between seed species susceptibility is because of the thickness of the seed coat, the nature of that coat and the size of the seed. Usually it is weed seeds that have waxy and thick coats that are the more difficult to control.

However, when weed seeds are not dormant i.e. they have germinated, **Basamid** is much more effective. Ensure therefore that soil conditions are warm and moist for maximum effectiveness (See pages 4—7).

It is difficult to give an individual rate per weed species, as there are so many factors to take into account.

As a general rule the concentration of MITC within the soil is affected by the depth of incorporation, so if weeds in the top few centimetres need to be controlled then a lower rate, incorporated to a shallow depth may be used in order to achieve the critical concentration. For deeper weed control, which will be needed for lettuce crops in a continuous cropping glasshouse, a higher rate will be needed to sterilise the soil to the depth required.

Weeds that propagate by rhizomes and stolons, or that have extensive deep roots may not be well controlled by **Basamid**. If this is the situation, other complimentary techniques such as the use of glyphosate prior to soil sterilisation are recommended before using **Basamid.**