

Basil production



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Basil production



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Part I: General aspects

1. CLASSIFICATION

Scientific name: *Ocimum basilicum*

Common names: Basil or sweet basil

Family: Lamiaceae

The name basil is derived from Greek word, *basileus* which means “king”, because of the royal fragrance of this herb.



The genus *Ocimum*

2. ORIGIN AND DISTRIBUTION

Basil is widespread in Asia, Africa and Central and Southern America. It appears to have its centre of diversity in Africa. There are more than 50 species of basil. These differ in growth habit, physiological appearance, and chemical and aromatic composition. Basil was probably first cultivated in India.

3. PRODUCTION LEVELS

South Africa

The expected essential oil yield is approximately 10 to 20 kg oil per ha. Yield of essential oil is between 0,2 and 1,3 % of the fresh mass. Leaf yields can range from 2,5 to 7,5 t/ha of dried material or 15 to 25 t/ha of fresh material.

Internationally

Today, basil is cultivated in many Asian and Mediterranean countries. Basil is cultivated extensively in France, Egypt, Hungary, Indonesia, Morocco and the United States, Greece and Israel.

The European sweet basil is cultivated and distilled in Europe, in the Mediterranean region. The United States crops are considered to be of the highest quality, producing the finest odour. The USA is the biggest producer and importer.

4. MAJOR PRODUCTION AREAS IN SOUTH AFRICA

Winter production can be achieved in the subtropical areas of South Africa such as the Mpumalanga lowveld, the coastal areas of KwaZulu-Natal and warmer areas of the Limpopo provinces. It will grow in summer, in cooler, high-lying regions of Gauteng, Mpumalanga escarpment and Free State provinces. The crop is frost sensitive.

5. DESCRIPTION OF THE PLANT

Stem

Basil is an erect herbaceous annual plant, or sometimes grown as a short-lived perennial in some areas. It grows into a bushy shape up to about 50 cm tall and some varieties may even grow taller. The stems are herbaceous in young tissue, however, these become woody as the plant matures.



Leaves

The leaves are broad, oval shaped and 5 to



Leaves of several different basil varieties: From left to right Mediterranean (sweet) basil, African Blue, lemon basil (*O. americanum*), spice basil, Thai basil (Siam Queen) and tree basil (*O. gratissimum*), upper and lower sides



8 cm long. The leaves are yellowish-green to bright green or red coloured and larger or smaller, depending on the form and variety, and on the fertility of the soil. The texture of the leaves varies from silky and shiny to dull and crinkly. Variation is the result of the many cultivars in use.

Flowers

Small white to purple flowers appear in summer and are arranged in whorls on the ends of branches.

Seed

The flowers produce seeds, which are oblong, ranging from brown to black in colour. The seeds self-sow readily and are easy to germinate as there is no dormancy requirement.

Essential parts

Leaves, stems and flowering tops are used. Basil is primarily cultivated for its aromatic leaves, which are used fresh or are dried for essential oil distillation, or for use as flavouring. Several ornamental varieties are sold for home gardens.

6. CULTIVARS

South Africa has two indigenous types that could have potential as essential oil crops, depending on the oil composition, namely Transvaal basil, *O. canum*, and Zulu basil, *O. urticifolium*. There are no registered cultivars in South Africa, however, commercially there are three major types of basil that have essential oil or dried leaves as the end product.

- ◆ French basil, reputed to be the sweetest in flavour and darkest in colour, is the most valued.
- ◆ American basil, noted for its rich colour, sweet flavour, cleanliness and uniformity of particle size, is considered to be of very high quality.
- ◆ Egyptian basil also known as Reunion or African basil has a camphoraceous fragrance and different flavour, and is considerably less expensive.



Transvaal basil, *Ocimum canum*

Seed populations obtained by many seed companies are not necessarily genetically uniform. Selected cultivars that can be grown from seed include:

- ◆ Sweet basil: Sweet, Genovese, Large-leaf, Mammoth
- ◆ Purple foliage basil: Dark Opal, Purple Ruffles
- ◆ Lemon basil: Lemon-scented, Lemon, Sweet Dani

Some other flavours: Cinnamon basil, Spicy bush, Camphor, Anise and Licorice.

7. CLIMATIC REQUIREMENTS

Temperature

Basil requires warm temperate or Mediterranean conditions, and should do well in most areas of the Republic of South Africa. It is best cultivated in subtropical, temperate regions. Optimum temperature for germination is 20 °C, with growing temperatures of 7 to 27 °C. The plant is susceptible to frost and cold temperatures and therefore develops best in long-day, full-sun conditions.

Rainfall

Basil cannot tolerate drought stress as the plant tissue is very tender. Annual rainfall of 700 mm is the minimum for dryland cultivation. Regular irrigation has to supplement rainfall where lacking, to maintain constant growth of the crop. Although basil may be irrigated with overhead sprinklers, drip irrigation is better. Plants grown with drip irrigation are less likely to develop foliar diseases than sprinkle-irrigated plants because the foliage stays dry. Black plastic mulch will enhance good yields of high-quality clean leaves.

8. SOIL REQUIREMENTS

Basil requires well-drained, fertile soils with a high organic matter content. It grows well in soils with a pH ranging from 4,3 to 8,2 and an optimum pH of 6,4. Basil has medium, deep roots and a high water requirement. Because moisture is important for a good basil crop, mulching the area will not only discourage weeds, but will maintain the moisture level of the soil, keeping the plants healthy.

Part II: Cultivation practices

1. PROPAGATION

Basil grows easily, however, it is highly susceptible to cold weather. For a producer who wants an early crop, seeds can be sown in seed trays. While in the greenhouse, the plant tops can be trimmed to encourage growth and lateral branching, and then be transplanted into the field when these have reached 15 cm in height, in approximately 4 to 6 weeks.

The transplants have to be hardened off by withholding some water and exposing the plant to outside conditions during the day with protection at night, before planting into the field. Basil may be cultivated either as a field-grown crop or in a greenhouse.

To ensure that the seed is true to type, high-quality seed should be obtained from reputable suppliers. Quality, trueness to type, high germination percentage and reliability are very important when considering the purchasing of seed. With direct seeding, an 80 to 90 % germination rate can be expected.

Basil can also be propagated by means of cuttings.



2. SOIL PREPARATION

Herbal and essential oil crops grown on natural soils yield products that are of high quality and in demand globally.

Producers are advised to have the soil analysed at a laboratory to check for mineral deficiencies and excesses, organic status and carbon ratios. Soil analysis will guide the producer in correcting the nutritional status of the soil.

Soil fertility levels have to be within acceptable ranges before a soil-building programme is started. Correct the soil pH according to analysis and soil type. Fertiliser use has to be planned according to whether the crop will be grown inorganically or organically.

Soil preparation has to be done according to good cultivation practices. Apply suitable soil preparation practices according to the farming operation (rip, plough, disc, harrow, contour, etc.). If mechanical harvesting and weed control is envisaged, prepare row widths adapted to the machinery to be used.

Producers who use the correct soil treatment will experience the benefit of producing crops of high value with less input in terms of weed, pest and disease control.

3. PLANTING

Planting density/spacing

High plant populations are recommended for essential oil and dried basil, while the fresh market requires long stems and larger leaves, a lower plant population is therefore recommended.

The recommended plant spacing is 15 to 30 cm in the row, and 50 cm to 1 m row width. The distance between the beds will be dependent on available cultivation equipment and end use. Double-row plantings on beds between 0,5 and 1,2 m wide are used with mechanical cultivation. Plant populations of 60 000 to 90 000 plants per hectare are used by most commercial producers.

Large commercial producers use a mechanical planter or a vegetable seeder. The seeding rate will depend on the desired planting density, which, in turn, depends on the end market.

Planting depth

The germination rate of the seed should be 80 to 95 %, and seeds should not be planted if the germination percentage is less than 70 %. For direct seeding, seed is planted only 3 to 6 mm deep at a spacing of 5 cm apart to ensure 80 to 90 % germination. The plants can then be thinned after emergence to the desired population. The soil should be kept moist for the seeds to germinate.

Planting date

Basil can be direct seeded or transplanted to the field in early or late spring, from August to October, after all danger of frost has passed. It can be planted in a nursery at an earlier date to protect it from cold and frost and then transplanted into the field when ready.

5. FERTILISATION

Fertiliser applications depend on the soil type, soil analysis recommendation and fertiliser applications for the previous crop. Overfertilising basil will result in fertile vegetal growth, but flavour will be impaired. Basil responds well to moderate fertility. The quantity of fertiliser to be applied will depend on the soil analysis results.

If basil is cultivated for essential oil, it has to be fertilised sparingly as this can decrease the fragrant oils.

6. IRRIGATION

Basil requires water in form of rain or irrigation regularly, throughout the growing season in order to maintain constant growth. Basil may be irrigated with sprinklers, however, drip irrigation is a better option. Plants grown with drip irrigation are less likely to develop foliar diseases than overhead irrigated plants because the foliage stays drier.

7. WEED CONTROL

Weed control is critical because competition with weeds decreases the quality of basil leaves. Cultivation practices such as high plant populations, shallow

cultivation, decreasing row spacing and mulching can be practised to keep weed populations low. Mechanical cultivation and manual weeding are some of the weed control methods that can be used.

Preventive measures include choosing a cultivar that has rapid seed germination and plant growth, using certified crop seed that is weed free, using weed-free mulch and cleaning the equipment before use. Weed control is enhanced with proper field preparation before planting. Both plastic and organic mulches may also be utilised to minimise weeds in the field.

Weed control guidelines

- ◆ Do not allow weeds to form seed in the land.
- ◆ No-till practices result in fewer weeds.
- ◆ Shade out weeds by the plant canopy, high plant density, closer row width, if moisture content of the soil and crop specification allow for it.
- ◆ Use manual or mechanical control.
- ◆ Some seeds germinate when exposed to sunlight. Use night ploughing as option for fewer weeds.

8. PESTS AND THEIR CONTROL

As basil is such a delicate plant, it will naturally attract pests of different kinds, for example:

- ◆ **Chewing-type damage:** beetles, slugs, leafminers, caterpillars, grasshoppers.
- ◆ **Sucking-type damage:** leafhoppers, thrips, whitefly species.

For prospective producers of herbal and essential oil crops, the following pest control guidelines are recommended.

Pest control guidelines

- ◆ Natural pest control measures should be used as first choice.
- ◆ Follow a pest management programme.

- ◆ Regular scouting of the crop is required.
- ◆ Early detection and management of pest problems can prevent major problems.
- ◆ Other organic methods, such as reflective mulches, insecticidal soaps, plant extracts, traps and handpicking of pests, water sprays and vacuuming, can be used.
- ◆ The knowledge of certain herbs that repel or attract insects can be used in companion planting for pest control.

Extension officers of the Department of Agriculture and researchers from agricultural institutes should be contacted for further information on the identification of insects and for recommended controls.

Use the publication* *A guide for the control of plant pests – 2002*, compiled by Annette Nel, Mareli Krause, Neervana Ramautar & Kathy van Zyl.

9. DISEASE CONTROL

Information on basil diseases and control is very limited. Basil is a special crop with only few pesticides registered that can be used on the crop. Natural control, such as parasitic wasps, spiders, and other general predators, can be of assistance in keeping pest populations at moderate levels.

Bacillus thuringiensis, a biological control agent that kills a variety of caterpillars, can be used on basil. Dichotomaceous earth can be used for snails. Other organic methods such as reflective mulches, beneficial insects, insecticidal soaps, plant extracts, pest traps, handpicking of pests and organic insecticides can be used.

Producers should therefore rely on early recognition and use of cultivation practices such as the use of windbreaks and rain shelters to prevent and manage diseases. By recognising the first symptoms of disease, producers can remove diseased plants and continuously monitor fields for signs of pathogen recurrence or spread of disease.

* Obtainable from the Resource Centre, Directorate Communication Services, Private Bag X144, Pretoria, 0001. Tel: 012 319 7141/7085. Fax: 012 319 7260

Frequent diseases in basil plants

Fungi

Various fungal organisms cause leaf spots, defoliation, tip dieback, stem lesions and sometimes loss of entire plants. At times, dead tissue within the leaf spots falls away, producing holes in the leaves. It also causes the plant to wilt, die back or decline.

Fusarium species causes major production losses. Early symptoms of this fungal disease include slow growth and yellowing of the young shoots. Advanced symptoms include wilting, die back and discoloration of stems. Longitudinal slices in the stem gradually develop owing due to discoloration of the stem beneath the bark.

Other soilborne pathogens such as *Rhizoctonia solani*, *Pythium* spp. and *Phytophthora* spp. have been associated with diseased plants. Further research is required to establish their roles in root disease.

CONTROL

- ◆ Removal of all diseased plants and leaves;
- ◆ Avoid introducing infected plants or soil onto the farm from contaminated areas;
- ◆ Avoid planting in wet, poorly drained areas;
- ◆ Sterilise harvesting equipment after use, especially when used on different plantations.

Bacterial pathogens

Bacteria cause water-soaked, dark, angular or irregular leaf rots, and brown to black, wet stem rot. When dry, diseased areas are brittle and crack easily. Bacterial diseases are extremely severe during wet weather and also cause stem rots. This then reduces quality and total production. Post-harvest losses are also very high.

Nematodes

Basil is very susceptible to root-knot nematodes, *Meloidogyne* spp. These microscopic, round worms damage the roots and impede the plants' ability to

take up water and nutrients from the soil. As a result, affected plants may show symptoms of nutrient deficiency, wilting and yield decline. Galls on roots and root rot occur on plants that are severely affected. Producers should check with agricultural chemical representatives, extension officers, or plant disease specialists for chemicals that are registered for soil treatments for nematode control.

Aphelenchoides sp. (foliar nematode), are microscopic, round worms causing angular leaf rots during wet weather. Spots are large, water-soaked, and black. *Aphelenchoides* sp. swim in the thin film of water covering the plant surface in high humidity or rain. These nematodes penetrate the leaves through stomates, then feed and multiply in the internal leaf tissue.

The addition of organic matter such as chicken manure may improve soil condition and reduce the effect of nematodes and other pathogens. Other cultivation practices for disease control include rotation with nonsusceptible plants and soil solarisation. A clear plastic sheet is placed over the soil for 6 weeks or longer. The plastic cover retains heat in the soil and reduces nematode numbers. Soil solarisation is effective only if used when sufficient sunlight is available to accumulate heat beneath the plastic cover.

9. OTHER CULTIVATION PRACTICES

Mulching

Growing basil with drip irrigation and black plastic mulch will ensure yields of high quality, and clean leaves. Organic mulches are also used.

10. HARVESTING

Maturing time and methods

Some producers of essential oils harvest basil only once and then during the full flowering stage. Other producers harvest the crop just as flowering commences and allows for regrowth to have additional harvests during the same season.

Up to 4 cuttings are possible. Commercial producers use a modified sickle-bar mower with an adjustable cutting height for harvesting. For fast regrowth, cuttings can be made at 100 to 150 mm above the ground. Harvesting should be done in warm, sunny weather, which will allow for a higher yield of oil. Make sure not to irrigate for a few days before harvest.

Fresh and dried produce

Leaves can be harvested when needed. The foliage should be cut at least 10 to 15 cm above the ground to allow for regrowth and subsequent crop. To ensure a continuous supply of leaves, the field harvests or planting dates can be spaced accordingly.

Foliage should be harvested before the plants bloom. Basil plants will seed and stop producing leaves if the flower spikes are not removed as these appear.

The ideal time to harvest basil that is to be dried, is on a sunny morning, immediately after the dew has evaporated, and before the day becomes too warm.

When harvesting basil for the fresh market, make the cuts 5 mm above a node and at a height of 10 to 15 cm, and leave sufficient foliage on the plant so that it can continue with healthy growth.

Part III: Post-harvest handling

1. SORTING AND DISTILLATION

Leaf cuttings of basil for the fresh market may be harvested from one to five times per season, depending on the area involved and the length of the growing season. Leaves should first be washed and cleaned, removing the weeds and extraneous materials. The basil should be refrigerated as soon as possible after

cutting, preferably in the field. Only the highest-quality basil with the best colour and aroma should be used for fresh market sales.

Before distillation, the basil plant is dried for 1 to 3 days at temperatures below 40 °C. The essential oil and oleoresin are extracted from the leaves and flowering tops *via* steam distillation.

2. GRADING

Colour, aroma and texture are the key elements for producing a quality fresh crop for the market.

The essential oils of basil are of complex and variable composition. Within the species, several different chemical races exist, and the climate, soil, cultivation practices and time of harvest influence not only the quantity, but also the composition of the essential oil.

The most important aroma components are 1,8 cineol, linalool, citral, methyl chavicol (estragole), eugenol and methyl cinnamate, although not necessarily in this order, in fact, hardly any basil type contains all of these compounds in significant quantities. Other compounds may also be present, depending on cultivar. African species often contain camphor.

3. PACKAGING

Fresh basil is very soft and damaged easily by rough handling, dehydration, and chilling. To ensure and maintain product quality, minimise bruising when harvesting and packaging. Harvested basil is usually dipped in cold water to remove soil particles and some of the insects that are not strongly adhering to the plant. It is then dried off prior to sorting and packing the product. Basil may be packed in bulk or packed in bunches, propylene bags or similar packaging used for herbs.

For a dried product, basil should be cut 15 cm above the ground. The foliage is stripped from the stems. Drying should occur in a warm, well-ventilated place to retain a good green colour. Commercial driers are used on bigger farms. Packaging in smaller containers is sometimes done where producers have the necessary facilities.

4. STORAGE

Essential oils are stored in air-tight fluorinated plastic, treated aluminum, dark glass or ceramic containers and stored in a cool, dry place.

Fresh basil can be stored at a temperature of between 8 and 10 °C to prolong its shelf-life. Basil is, however, highly sensitive to chilling, with typical symptoms of damage being blackening of leaves and aroma loss. Fresh basil can be stored for 7 to 10 days at the recommended temperature.

Dried leaves are stored in dark, air-tight containers and are therefore marketed.

5. MARKETING

Fresh basil is marketed at fresh produce markets, supermarkets, hotels and restaurants, specialty food outlets such as pizza places, wholesalers and retailers.

Markets for the dried product have to be established before production begins. The quality of the product is determined by taste, flavour, moisture content and cosmetic appearance for the fresh market, as well as volatile oil content and total insoluble ash content for the processing market.



Dried basil

Essential oil market

The major market in the world for essential oils is the United States, followed by Japan and Europe. However, production continues to be concentrated in Europe, with seven of the world's largest essential oil processing firms.

In the United States, the major users of essential oils are the soft drink companies. Japan accounts for 10 % of the world demand. The Canadian market is dominated by the United States perfume and flavouring industry.

France is dominating the world perfumery market, and Switzerland is one of the leaders in the pharmaceutical field. Britain and India are known to feature strongly in the flavouring sector.

The essential oil industry is characterised by a number of difficulties, including lack of stable quality, inconsistent supplies and variability of active ingredients owing to environmental effects. This has encouraged many of the end users to depend on synthetic oils in an effort to eliminate these problems. The result is a weaker market for naturally produced essential oils.

With the increased interest in “natural” products and new health consciousness of the public, as well as the fact that a natural product is perceived to have a superior quality, there is an opportunity to effectively market naturally produced essential oils, should the problems mentioned be addressed. Price differences exist between the types presented according to buyer requirements.

Part IV: Production schedules

As farming enterprises are so diverse, a very basic schedule is proposed. Producers have to adapt the schedule to their own needs.

Production schedules might differ considerably according to climate, region, topography, slope, rainfall and availability of irrigation. Producers should take into consideration the fact that there are other soil preparation practices such as no till or minimum tilling. Weed, pest and disease control will also be influenced by climate, rainfall and region. Consequently there is no “typical schedule” for any of these crops; it should be adapted depending on the region and existing agricultural conditions, practices, equipment and infrastructure.

As basil is sometimes grown as a perennial, allowance is made for cultivation practices throughout the year.

General crop schedule – Thyme												
Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Field preparation												
Rip and plough												
Disking												
Prepare seedbed												
Planting, cultivation and harvesting												
Plant and transplant												
Weed control												
Pest control												
Disease control												
Irrigate												
Harvest												

Part V: Utilisation

Basil is cultivated for the fresh market as a culinary herb, as a condiment or spice in the dried/frozen leaf form, and as a source of aromatic essential oil for use in foods, flavours and fragrances and as a potted herb and bedding plant.

As a fresh or dried market herb, the main type traded, includes the large-leaf, highly aromatic French or Italian basil, though several other types, which differ in leaf shape and aroma, are of commercial importance in the fresh market industry (i.e. basil with a lemon, licorice or cinnamon aroma).

Basil (*Ocimum basilicum* L.) is a source of essential oils extracted by steam distillation from the leaves and flowering tops and is used to flavour foods, in dental and oral products and in fragrances.

1. MEDICINAL/PHARMACEUTICAL

Basil acts principally on the digestive and nervous systems, easing flatulence, stomach cramps, colic, and indigestion. It prevents or relieves nausea and vomiting, and assists to kill intestinal worms. It has a mildly sedative action, proving useful in treating nervous irritability, tiredness, depression, anxiety, and insomnia. It may also be taken for epilepsy, migraine and whooping cough.

Basil has been traditionally taken to increase breast milk production. Applied externally, basil leaves act as an insect repellent. The juice from the leaves brings relief to insect bites.

Other uses – Altitude sickness, ovulation pain.

Basil has an established antibacterial action. Extracted essential oils have also been shown to contain biologically-active constituents that are insecticidal, nematicidal, fungistatic or which have antimicrobial properties. These properties can frequently be attributed to predominant essential oil constituents such as methyl chavicol, eugenol linalool, camphor and methyl cinnamate. Two minor components of the essential oil of sweet basil, juvocimene I and II have been reported as potent juvenile hormone analogues (Simon *et al.* 1990).

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* Further information on references could be obtained from members of SAEOPA and KARWYL Consultancy.

