Fennel Seed Grower Guide

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Quick Grower Facts

Time of Sowing – Sow from late April to mid-May, in Central Queensland, North Queensland and the Katherine/Douglas Daly region in the Northern Territory. Ideally when average daily temperatures are below 20°C.

Sowing Rate – 4 to 7 kg/ha depending on sowing method and type of planter used. Broadcasting requires higher rates, whilst drill sowing uses lower rates and combine planters require higher rates than precision planters. The best establishment is achieved when drill sown.

Sowing Depth – 15 to 20 mm.

Row width – The ideal spacing is 40 to 50 cm, but row spacings from 25 to 100 cm have been used to adapt with existing farming systems.

Soil Types – Can grow in a wide variety of soils, prefers soils with high levels of organic carbon that are free draining. Fennel does not grow well in sandy soils.

Crop Nutritional Requirements for N, P, K & S

- Pre-plant or at planting apply 50 kg/ha of nitrogen and a minimum of 20 kg/ha of phosphorus and 20 kg/ha of sulphur. This can be applied in the lead up to sowing.
- Approximately 30 to 60 days after sowing top up with an additional 40 – 70 kg/ha of Nitrogen, 50 – 80 kg/ha of potassium and 10 – 15 kg/ha of sulphur.

Water Management & Irrigation – Fennel should be sown into soil with a full moisture profile and the moisture maintained until the crop emerges. After emergence, good soil moisture is required during branching, flowering and seed filling to maximise yields. Fennel does not like being waterlogged.

Weed Management – Ensure that a field with low weed pressure is chosen. Ideally, prepare the field in advance, allow weeds to germinate and control these prior to sowing, as currently there are no herbicides registered or permitted for use in seed fennel.

Diseases – Damping off or seedling rot can occur during crop establishment if conditions are too wet after sowing. Conduct a PredictaB prior to sowing to identify disease risks as this can help to manage disease through manipulating the environment such as soil moisture.

Insect Management – Fennel seed yields can improve with the presence of pollinators. During flowering and seed fill, aphids may accumulate around the umbel and should be managed to improve yields.

Harvest Management – If there is residual soil moisture at physiological maturity, apply a desiccant to dry the crop down in preparation for harvesting.

Harvest Timing – Harvest when seed moisture is at or below 8%.

Harvesting equipment – Use a standard grain header with a draper style or platform front.

Preferred Citation:
Rixon, C et al (2025) Fennel Seed Grower Guide. https://crcna.com.au/projects/great-northern-spices/ Published 01/2025

Introduction

Fennel (*Foeniculum vulgare* Mill L) is a hardy biennial or perennial herb that belongs to the Apiaceae family. Fennel has long thin feathery leaves and produces umbels of yellow flowers (Singh 2017). It is native to the Mediterranean and is now cultivated in many temperate and subtropical regions around the world.

Fennel has been cultivated in Tasmania since the early 1980s for oil production (*Fennel* 2024). It is also cultivated in some regions of southern Australia as a vegetable and is showing potential to be grown in winter in northern Australia as a spice crop. The varieties of fennel used for bulb production differ from those used for oil and seed production.

Production Potential and Markets

The major producers of fennel today are India, Egypt, Turkey, Syria, Iran, Germany, Spain and Pakistan with India producing approximately 150,000 tonnes of fennel in 2018 (Rahman et al. 2024). Australia currently imports its fennel seed from China and India (Rahman et al. 2024), as the fennel currently produced in Australia is used for essential oils or is a different variety cultivated as a vegetable.

Fennel seeds are predominantly produced for use as a spice in cooking; however, they can also be used to produce fennel oil which is used as a flavouring. Average crop yields in India vary annually from 1.3 to 1.7 t/ha while in Turkey, average annual yields range from 0.95 to 1.45 t/ha (Rahman et al. 2024).

Crop Establishment

Fennel can be grown in a wide range of soil types but prefers soils with high levels of organic matter that are free draining but does not grow well in shallow sandy soils (Dheebisha & Vishwanath 2020).

In northern Australia, fennel has grown in Hillview soils (Kandosol) in North Queensland Wet Tropics, Tipera (Kandosol) soils in Katherine and Annandale (kandosol) and Rolleston and Rockhampton (vertosol) soil in Central Queensland. All these soils are well drained, and the textures range from loams to cracking clays.

As fennel is a small seed, seed bed preparation is important with the soil needing a good fine tilth where conventional tillage methods are used to ensure good seed to soil contact, and accurate depth of sowing. Fennel can be sown by either broadcasting the seed and lightly incorporating using finger or diamond harrows or drilled into rows. Drilling fennel into rows achieves greater yields than using the broadcast sowing method (Sarker et al. 2023). The current recommendation is for fennel to be sown at a rate of 4 – 7 kg/ha, using the top rate if broadcast sowing and lower rates for drill sowing. If using a precision planter such as a Monosem, use 120 hole plates with 1.0 mm holes, and use the low seeding rates, and use higher rates if using a traditional combine style planter (Figure 1).

Figure 1: *Planters that have been used to sow fennel. Top Left: Cone seeder in Katherine, NT; Top Right: Connor Shea disc seeder in Tully, QLD; and Bottom: Monosem precision planter in Emerald, QLD.*

When drill sowing fennel, ideally it should be sown at a depth of 1.5 to 2 cm, using a row spacing of 40 to 50 cm, with 15 cm between plants within the row. Current row spacings vary from 25 to 100 cm to suit existing farming systems and sowing equipment.

Time of sowing

Fennel will germinate at temperatures between 5 and 35°C (Kamkar 2014); however, the optimum soil temperature for germination is between 16 and 18°C resulting in germination within 8 – 10 days (Dheebisha & Vishwanath 2020). This makes sesame a suitable winter crop for Central Queensland (Figure 2), the Atherton Tablelands in North Queensland (Figure 3), coastal regions of North Queensland (Figure 4) and the Douglas Daly/Katherine region in the Northern Territory (Figure 5).

Fennel seed production and quality is greatest when seed set coincides with cool (15 - 20° C) and dry weather conditions. Days from sowing to 50% of plants flowering ranges from 62 to 85 days depending on temperatures. Fennel would ideally be sown from late April to end of May so flowering could coincide with the months of June, July, and August, when weather conditions are cool and dry. Planting fennel from August onwards as temperatures increase, results in a shortened period of time from sowing to flowering and to harvest, with the higher temperatures during seed set resulting in lower yields (Dheebisha & Vishwanath 2020).

Fennel will be mature for harvest 155 to 185 days after sowing, depending on temperature and moisture. The harvest window for crops sown late April to end of May is late October to early December, allowing the crops to be harvested before the summer rains begin.

Water Management

As fennel yields are maximised if grown under cool dry weather conditions, water management is important. For good germination, fennel should be sown into soil with a full moisture profile, and soil moisture maintained until the crop emerges, which is generally 12 to 14 days after sowing.

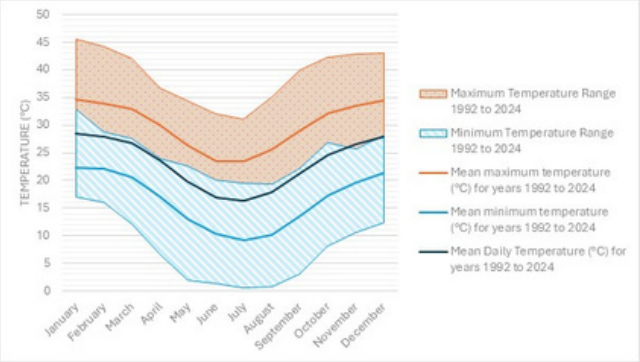

Figure 2: *Minimum and maximum temperature ranges and average daily temperatures recorded for Emerald in Central Queensland from 1992 to 2024.*

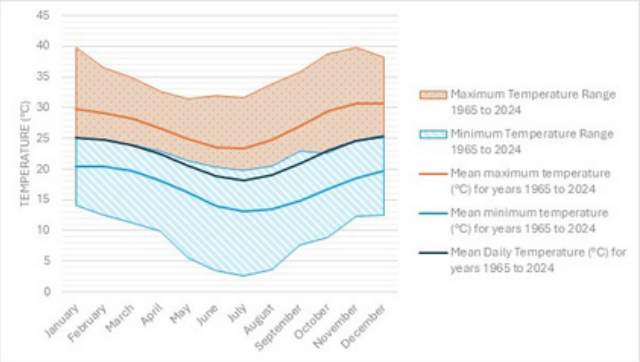

Figure 3: *Minimum and maximum temperature ranges and average daily temperatures recorded for Walkamin on the Atherton Tablelands from 1965 to 2024.*

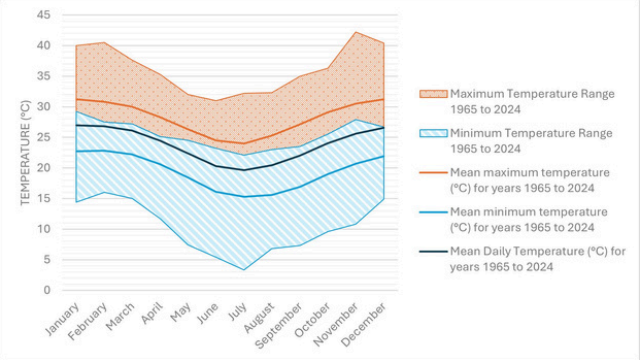

Figure 4: *Minimum and maximum temperature ranges and average daily temperatures recorded for South Johnstone in Coastal North Queensland from 1965 to 2024.*

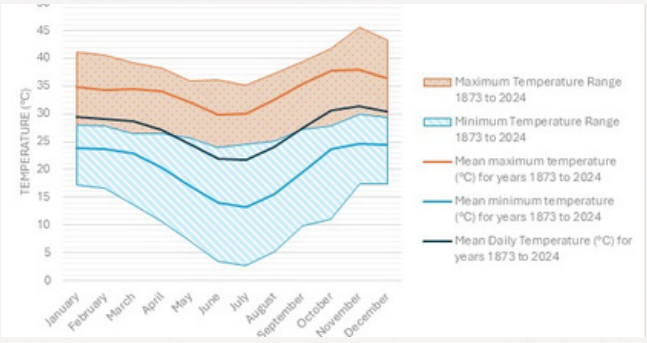

Figure 5: *Minimum and maximum temperature ranges and average daily temperatures recorded for Katherine in the Northern Territory from 1873 to 2024.*

To maximise crop yields, irrigation may be required after emergence, scheduling as frequently as 10 to 15 days, depending on the water holding capacity of the soil and the evapotranspiration. The most critical times for irrigation after emergence are during branching and seed filling, however the yields are greatest if irrigation is also maintained during flowering (Kumar, Singh & Chhillar 2002). Care needs to be taken however, to ensure the crop is not over watered, as fennel does not produce well when it is waterlogged (Dheebisha & Vishwanath 2020).

Crop Nutrition

Fennel requires between 90 and 120 kg/ha of nitrogen (N), 20 to 50 kg/ha of phosphorus (P), 50 – 80 kg/ha of potassium (K) and 20 – 40 kg/ha of sulphur (S) depending on the relative availability of N, P, K and S as determined by a soil test prior to planting.

The general recommendation is to apply and incorporate 50 kg/ha of nitrogen, the crops full phosphorus requirements and 10 to 15 kg/ha of sulphur, prior to or at the time of sowing. The remaining 40 - 70 kg/ha of nitrogen, 50 – 80 kg/ha of potassium and remaining 10 – 15 kg/ha of sulphur should then be applied as a top dress 30 to 60 days after sowing when the crop is branching and prior to flowering. This can be achieved through the application of DAPS at 250 kg/ha prior to or at sowing, and then top dress with a product such as CK 50/50S or equivalent at 300 kg/ha.

This recommendation will vary depending on the availability of nutrients in the soil as indicated by the pre-plant soil test, and with future fine tuning of nutrient requirements for specific regions and soil types.

Harvest Management

Fennel seed has traditionally been hand harvested, with multiple harvest timings within a single harvest period. In Australia, fennel seed is mechanically harvested using a standard commercial grain

Figure 6: *Heading a fennel crop with a KEW plot header in Tully, North Queensland, December 2024.*

header with a flat or draper style front. For the seed to be machine harvested, the crop needs to be properly desiccated when the seed moisture is 8% or lower. If this cannot be achieved naturally, the use of a crop desiccant would be beneficial.

Diseases and their Management

There are several diseases known to infect fennel. If conditions are too wet at sowing and emergence, fennel may suffer from damping-off which can cause the seedlings to rot, or germinate and collapse, and eventually die, preventing good crop establishment. The most common causes are Pythium spp. and Rhizoctonia solani (Dheebisha & Vishwanath 2020).

As the crop matures it may become infected with root and crown rot, stem rot, Botrytis blight, Cercospora leaf blight, Alternaria blight powdery mildew, downy mildew, and rust (Dheebisha & Vishwanath 2020). Fennel can be affected by a number of viral diseases, including alfalfa mosaic virus, celery mosaic virus, coriander feathery red vein virus, cucumber mosaic virus, tobacco mosaic virus, and tomato spotted wilt virus. Root-knot

nematode is reported to affect fennel as well.

So far, none of these diseases have been recorded in the fennel seed crops grown in Northern Australia, however this is likely to change as greater areas of fennel are grown.

There is currently a very limited range of chemical control options for fennel seed crops, for the control of fungal diseases. The list of products registered or under permit are shown in Appendix 1.

Fungal diseases can be prevented by planting in free-draining soil, good water management, planting disease-resistant cultivars, avoiding overcrowding through correct planting density to allow airflow through the crop to reduce leaf diseases, rotating with non-host plants, and weed management to reduce other host species for these diseases must all be considered.

The levels of soilborne pathogens, including Pythium spp. or Rhizoctonia solani in the soil can be quantified using a Predicta B Test prior to crop establishment, for disease risk management decision-making.

PREDICTA B TESTING AND DISEASE IDENTIFICATION

For more information on where to get a Predicta B test done and how to interpret the results visit:- https://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b#toc_Pathogens-tested

If disease symptoms are observed within the crop, establish the incidence and severity of the disease, take photos of the disease symptoms and send a sample of the diseased plant along with the photos to a nearby plant pathologist for identification, or to:-

Dr. Dante L. Adorada,
Centre for Crop Health,
University of Southern Queensland,
Toowoomba Qld 4350.
T: 0477718593
E:dante.adorada@unisq.edu.au.

Insects and their Management

Insects generally don't cause significant damage to the fennel seed crop because the essential oils which are most concentrated in the seed have insecticidal, fungicidal and bactericidal activity (Pavela et al. 2016). Fennel seed yields also improve with the presence of insect pollinators, such as honeybees during flowering (Ali, Al-Farga & Seddik 2024), so it is best to avoid the use of insecticides whilst the crop is flowering.

Aphids have been observed to accumulate around the umbel during flowering and seed fill in fennel seed crops in Northern Australia (Figure 7). If the aphid population gets too high, it may be necessary to release predators to reduce the population, as it has the potential to impact on crop yields and currently there are no insecticides registered or under permit for use in fennel seed crops in Australia.

Figure 7: *Aphids accumulating on the umbels during seed fill in a crop of Fennel in Biloela, Central Queensland.*

Weeds and their Management

There are currently no chemical weed management options registered or under permit for use in fennel crops grown for seed for human consumption. The first 50 days after emergence is the critical window for weed control to maximise crop yields (Dheebisha & Vishwanath 2020). To achieve good weed control in fennel there are a few guidelines to follow.

1. Select a field with low weed pressure.
2. Irrigate the field prior to planting to encourage the first flush of weeds prior to sowing. If it is a conventional farming system, conduct a light tillage prior to the irrigation. Weeds can then be controlled with either a system herbicide containing the active ingredient glyphosate or by using knockdown herbicide such as those containing the active ingredient glufosinate or paraquat as a single application or a systemic. These can be used as either a single or double knock application strategy.
3. Plant when conditions are conducive to good emergence and with correct nutrition to ensure good healthy crop establishment, so the fennel crop can out compete the weeds.
4. Plant on a 40 – 100 cm row spacing and use mechanical cultivation 40 to 45 days post crop emergence. Newer technology such as microwave or laser weed control may be useful in the future.

Figure 8: *Wild Sunflower in a winter crop in Emerald, Central Queensland.*

Figure 9: *Common Pigweed at Katherine Research Station, Northern Territory.*

Figure 10: *Young Pink Convolvulus vine just starting to run in Tully, North Queensland.*

Key Weeds

Wild Sunflower (Verbesenia encelioides) also commonly known as Crownbeard is an erect branching plant that grows up to 130 cm in height and is a common weed in Central Queensland (Figure 8). It has yellow daisy like flowers that resembles a sunflower, which forms a globular seed head in spring and summer. This weed will compete with the fennel crop for nutrient, soil moisture and sunlight.

Common Pigweed (Portulaca oleracea) is a prostrate succulent weed (Figure 9) that forms a thick mat that can smother out young plants during crop establishment, and later in the crop will compete with the fennel for nutrients and soil moisture. It produces a small black seed about 1mm in diameter.

Pink Convolvulus (Ipomea triloba L) is a fast-growing vine with thin stems and ivy-like leaves (Figure 10) that is common in North Queensland, particularly in the coastal regions. It has a tubular bell-shaped flower that varies in colour from pink to lavender.This vine will usually become established later in the crop, and due to its rapid growth can spread very quickly and will climb up the fennel plant. Pink convolvulus if present, causes issues for harvesting and if thick, can become entwined around the reel, or even stall the header.

Appendix 1 - Chemicals registered or under permit for use in sesame.

These details are correct at the time of publication. Always refer to the product labels or the relevant permits for full details, prior to recommending or using any products.

For permit details go to – https://portal.apvma.gov.au/permits

Fungicides

Product	Group	Rate	WHP	Critical Comments
500 g/kg Copper oxychloride (Various) 375 g/kg Cupric Hydroxide (Various) 500 g/kg Cuprous Oxide (Various) 190 g/L Tribasic Copper Sulphate (Various) PER92834 (Valid to 31 January 2026)		500 g/kg copper oxychloride 250 g/100L 375 g/kg cupric hydroxide 140 g/100L 500 g/kg cuprous oxide 155 g/100L 190 g/L tribasic copper sulphate 280 mL/100L		• Apply at the first signs of disease as a foliar application. • Apply using airblast sprayer, air-shear sprayer, boom sprayer, knapsack sprayer or equivalent. • Repeat applications at 7-10 days intervals when conditions favour disease development. • Use a maximum spray volume of 500 L/ha. • Ensure thorough spray coverage of all foliage. • DO NOT apply more than 6 applications per crop. • Adhere to all Safety Directions and First Aid Instructions listed on the respective labels

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The authors acknowledge the financial support of the Cooperative Research Centre for Developing Northern Australia which is part of the Australian Government's Cooperative Research Centre Program (CRCP). The CRCNA also acknowledges the financial and in-kind support of the project participants.

Australian Government
Department of Industry, Science and Resources
Cooperative Research Centres Program

A publication of the Cooperative Research Centre for Developing Northern Australia, January 2025.

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