Kalonji Grower Guide

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Quick Grower Facts

Time of Sowing – Sow from late April to mid-May, in Central Queensland, Atherton Tablelands in North Queensland and the Katherine/Douglas Daly region in the Northern Territory.

Sowing Rate – 5 to 15 kg/ha depending on the planter, with precision planters requiring lower seeding rates and seed quality, with fresh seed with good viability a necessity.

Sowing Depth – 5 to 15 mm.

Row width – 5 to 60 cm, to adapt with existing farming systems, with a within row spacing of 5 to 15 cm. Optimum plant density is 40 to 60 plants per m2.

Soil Types – Can grow in a wide variety of soils, however, prefers loamy and sandy soil that are well drained with high organic carbon levels. Attention needs to be paid to crusting soils as these can affect emergence. Ideal soil pH for Kalonji is 7.0 to 7.5 but will grow when pH is between 5.0 and 8.5. The soil should be prepared to a fine tilth to optimise seed soil contact.

Crop Nutritional Requirements for N, P & K

- Pre-plant or at planting apply 30 - 45 kg/ha of Nitrogen, 20 kg/ha of Phosphorus, 60 kg/ha of Potassium. This can be applied in the lead up to sowing.
- Approximately 60 days after sowing top up with an additional 30 - 45 kg/ha of Nitrogen.

Water Management & Irrigation – Kalonji requires soil moisture of 40 to 80% at sowing for germination. Kalonji performs best when soil moisture is maintained around 60% or -0.03MPa if tensiometers are available, during germination, vegetative phase, flowering and seed formation.

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

Diseases – Potential major diseases for Kalonji are Foot and Root rot. The use of raised beds with the application of Trichoderma in compost is effective to manage this disease. Conduct a PredictaB prior to sowing to identify disease risks to target in crop management.

Insect Management – Monitor for Fall Armyworm and Soyabean looper.

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.

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Introduction

Kalonji (Nigella sativa) also known as Nigella or Black Cumin belongs to the family Ranunculae and originated in either Turkey or Italy. Kalonji is a small annual herb that grows from 30 to 69 cm in height and produces small black seeds (Ashraf, Ali & Iqbal 2006).

The seeds from Kalonji are used both as a spice additive to foods, and to produce oils which can be used as a flavouring in cooking. In many countries, Kalonji seeds and oil are also used for medicinal purposes.

Production Potential and Markets

Kalonji was cultivated in Iran, Japan, China, Indonesia, Turkey, India, Sri Lanka, Bangladesh, Pakistan, Afghanistan, Egypt, Iraq, Syria and Ethiopia (Cahyo et al. 2020; Jamir, Chattopadhyay & Ch. Momin 2021). India, Syria, Ethiopia and Turkey are the major exporters of Kalonji (Jamir, Chattopadhyay & Ch. Momin 2021) with Turkey producing 6425 tonnes of Kalonji from an area of 8391 hectares in 2021 (Kayacetin 2022).

Australia is currently importing Kalonji seeds, with 70.3 tonnes being imported from India between the 16 February and 15 October 2016, with the price ranging from $4,000 to $10,000 per tonne (Rahman et al. 2020). The trading price of Kalonji ranges from US$ 2,258/tonne to US$2,900/tonne with Kalonji from Egypt attracting higher prices than that from India (Rahman et al. 2020).

Locally produced Kalonji would be able to be marketed in Australia first, before targeting the international market. Early-stage trials in Northern Australia have shown yield potential of Kalonji ranges from 800 to 1200 kg/ha (Mani et al. 2022).

Crop Establishment

Good crop establishment is critical for any crop to maximise yields. Kalonji prefers loamy and sandy soil that are free draining with high organic carbon levels but will grow in a wide range of soils (Shahzadi et al. 2023).

As Kalonji is a small seed, it is recommended that the ground is prepared to create a fine tilth prior to planting and if drainage is poor, form raised beds. Kalonji is best sown in rows, with row widths varying from 25 to 60 cm, and seeding rates varying from 5 to 15 kg/ha depending on the quality of the seed and field conditions to achieve the optimum plant density of 40 to 60 plants per m2. Lower seeding rates can be used when sowing with a precision planter (Figure 1), and higher rates used when sowing with combine style planters or when conditions for crop establishment are not ideal. When sowing with a Monosem or similar precision planter use 120 hole plates with 0.8 or 1.0 mm holes.

When sowing Kalonji, aim for a seeding depth of 5 to 15 mm, depending on the available soil moisture. The ideal plant spacing within the row varies from 5 to 15 cm depending on the row spacing.

Figure 1: *Monosem precision planter used for sowing Kalonji on 30 cm row spacing in Emerald, QLD.*

Time of sowing

Kalonji is a subtropical plant that performs best when average daytime temperatures are between 14 and 26°C but will tolerate temperatures up to 30°C (Shahzadi et al. 2023), making it a suitable winter crop for Central Queensland (Figure 2), the Atherton Tablelands in North Queensland (Figure 3) and the Katherine/Douglas Daly region in the Northern Territory (Figure 4). The optimum daytime temperature for germination is 12 - 18 °C, however once the temperature increases over 25°C, germination starts to decrease (Shahzadi et al. 2023). During flowering and seed setting, cool moist conditions are required to optimise crop yields and seed quality.

From sowing to harvest takes 140 – 186 days, depending on variety, daytime temperature and available soil moisture. Where there is insufficient moisture the crop growth stage will shorten. The ideal time to sow Kalonji is late April to mid-May, to coincide with cooling temperatures, and to ensure that flowering and seed setting is occurring when temperatures are low to maximise crop yields.

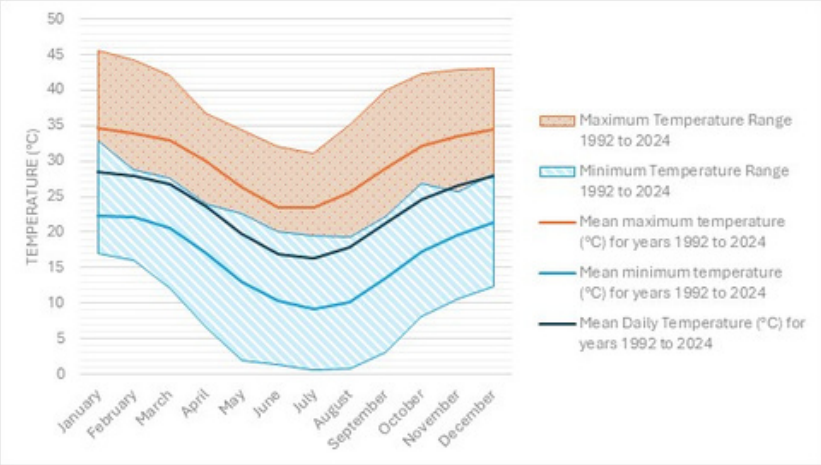

Figure 2: *Minimum and maximum temperature ranges and average daily temperatures recorded for Emerald in Central Queensland from 1992 to 2024.*

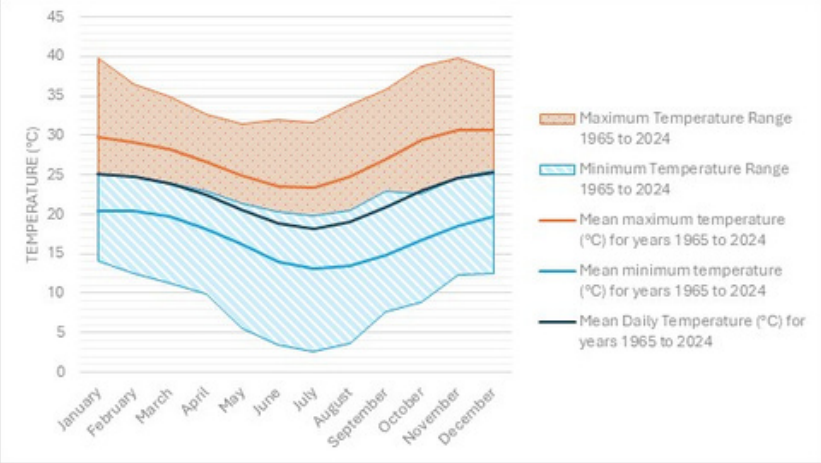

Figure 3: *Minimum and maximum temperature ranges and average daily temperatures recorded for Walkamin on the Atherton Tablelands from 1965 to 2024.*

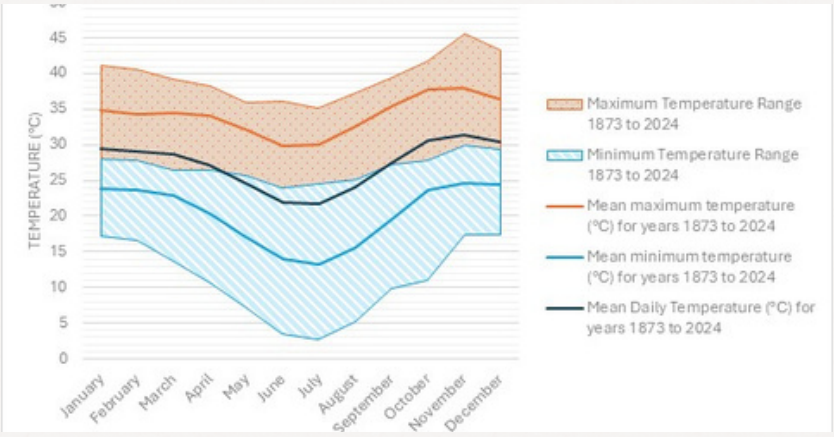

Figure 4: *Minimum and maximum temperature ranges and average daily temperatures recorded for Katherine in the Northern Territory from 1873 to 2024.*

Water Management

Kalonji is known as a drought resistant crop which can grow on 120 – 400 mm of rainfall during the crop season (Shahzadi et al. 2023). Winter in Central Queensland and the Katherine/Douglas Daly regions is regarded as the dry season and do not receive sufficient consistent rainfall; thus, Kalonji will require irrigation to maximise crop yields.

The critical crop stages for irrigation to be applied to the Kalonji crop is soon after sowing, during the vegetative phase, flowering and seed formation (Adil, Akmal & Afzal 2014; Day et al. 2022). Seed germination is maximised when the soil moisture at sowing is 60%, with the rate of seed germination decreasing when the soil moisture increases to 80% or decreases to 40% (Shahzadi et al. 2023). When there is sufficient soil moisture during flowering and seed development improves the oil content of the seed and results in a larger seed size at harvest (Shahzadi et al. 2023).

Where tensiometers are available, it has been determined that Kalonji achieves its best yields when the soil moisture tension at a depth of 20 cm is maintained at -0.03 MPa, or in the absence of tensiometers, a soil moisture of 60% (Goswami 2011; Shahzadi et al. 2023)

Crop Nutrition

The ideal soil pH range for Kalonji is 7.0 – 7.5 but will grow when soil pH is between 5.0 and 8.5. If soils are acidic ameliorate with lime to increase soil pH.

Kalonji yields will be optimised with the application of nitrogen (N), phosphorus (P), potassium (K) and sulphur (K).

As Kalonji is high in protein, the application of N is essential to improve crop yields, with Kalonji requiring 60 – 90 kg/ha (Adil, Akmal & Afzal 2014; Mehmood 2018). The total N requirement can be applied at or prior to planting, however yield improvements have been gained by applying 50% of the N at or prior to planting, and then the remaining 50 % should be applied 60 days after sowing or split into two applications applied 60 and 90 days after sowing (Adil, Akmal & Afzal 2014; Mehmood 2018; Rehman et al. 2022).

Kalonji also requires 20 – 40 kg/ha of P, 50 – 90 kg/ha of K and 9 – 12 kg/ha of S, which should be applied and incorporated prior to, or at planting.

Harvest Management

Kalonji is being harvested in Northern Australia using a standard grain header with a flat front. The plant grows to a height of 20 to 60 cm and is physically mature when the seeds within the pods have turned dark brown/black. Termination of irrigation at the end of seed set will allow the crop to dry down naturally, alternatively the use of a desiccant may be beneficial.

Elsewhere, Kalonji is harvested by pulling the plant out, bundling it and hanging it up to dry, and then the seed is threshed; thus, Kalonji may be suitable for windrowing. The Indian Agmark grade specifications identify seed moisture needs to be less than 11percent (Malholtra 2012), and as there are no current guidelines for mechanical harvesting, this along with experience from similar crops would suggest seed moisture content should be less than 8 percent at harvest. Monitoring of seed losses during mechanical harvesting will allow this to be refined, as if there is too much seed remaining in the pods, the seed moisture is too high, providing attempts have been made to adjust concave and fan settings.

Diseases and their Management

Kalonji cultivation in Australia is still at its infancy, and so far, no disease has been detected in the limited number of trials conducted. Foot and root rot is one of the most serious constraints in Kalonji cultivation. Using raised beds along with the application of Trichoderma mixed compost at 50 kg/ha is an effective combination to manage this disease. Alternatively, the use of a suitable seed treatment that will be effective against root rot, could become necessary in the future. Other major diseases reported to infect Kalonji include wilt, blight, and powdery mildew (Shahzadi et al. 2023).

Currently there are no chemical products registered or under permit for disease control in Kalonji. As such, careful management of irrigation, avoiding overhead irrigation to prevent the canopy from remaining wet for an extended period and correct planting densities and row configurations to allow good air circulation through the crop would assist with managing these diseases.

Insects and their Management

Kalonji is a reported to host both Fall Armyworm and Soyabean looper, which feeds on the seeds and the flowers and can reduce crop yields (Shahzadi et al. 2023). No insect damage has been recorded to date in trial crops grown in Northern Australia. There are currently no insecticides registered or permitted for use in Australia.

Weeds and their Management

Keeping the Kalonji crop weed free for the first 40 days is the key to maximising yields. Currently there are no herbicides registered for use in Kalonji in Australia, making integrated weed control critical.

Firstly, select a field where weed seed bank pressure is low to minimise weed pressure in crop. To further reduce weed pressure in crop, allow the first flush of weeds to germinate prior to sowing and apply a knock down herbicide such as paraquat or glufosinate if annual weeds are present or a systemic herbicide such as glyphosate for hardier or perennial weeds. This practice is called the stale seedbed technique. Once the crop has germinated, aim to carry out mechanical cultivation 30 and 60 days after sowing when necessary to control weeds in crop.

Overseas research has shown that S-metolachlor is a safe and effective pre-emergent when applied after sowing (Zia Ul Haq et al. 2024), however further research needs to be conducted under Australian conditions.

Key Weeds

Common Pigweed (Portulaca oleracea) is a prostrate succulent weed (Figure 5) that forms a thick mat that can smother out young plants during crop establishment, and later in the crop will compete with the kalonji for nutrients and soil moisture. It produces a small black seed about 1mm in diameter, which is difficult to separate from Kalonji seeds.

Figure 5: *Common Pigweed at Katherine Research Station, Northern Territory.*

Black Pigweed (Trianthema portulacastrum) also knowns as giant pigweed is a prostrate succulent weed commonly found in Central Queensland (Figure 6). Black pigweed can form a thick mat that can smother young plants during crop establishment and later in the crop will compete for nutrients and soil moisture. The stem varies in colour from dark green to a reddish-brown colour and produces a small flower 3 to 4 mm long that varies in colour from light pink to white. Giant pigweed produces black seeds that are 1.5 to 2.0 mm wide and are unable to be separated from Kalonji seeds.

Figure 6: *Black Pigweed at Emerald, Central Queensland.*

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