Canola

PRODUCTION GUIDELINE

agriculture,
forestry & fisheries

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REPUBLIC OF SOUTH AFRICA

Canola

Production guideline

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Content

General

CLASSIFICATION

Scientific name: *Brassica napus* L.
Common names: Canola, oilseed rape, rapeseed, rape, kanola (Afrikaans)

ORIGIN AND DISTRIBUTION

Canola is a special biotype of rapeseed. The word “canola” is derived from “Canadian oil, low acid”. Rapeseed, is an oilseed plant originating from an ancient civilisation as far back as 3 000 years ago in India. Canola was developed through breeding from rapeseed. The word “rape” in rapeseed comes from the Latin word “rapum,” meaning turnip. Turnip, cabbage, brussel sprouts, mustard and many other vegetables are related to canola. The negative associations with the word “rape” in North America resulted in the more marketing-friendly name “canola”.

Rapeseed had been grown in Canada (mainly Saskatchewan) since 1936. Canadian plant breeders improved the quality of the plant. In 1968, Dr Baldur Stefansson of the University of Manitoba used selective breeding to develop a low erucic acid variety of rapeseed. In 1974, another variety was produced with low erucic acid content and a low level of glucosinolates, the two factors limiting its use as food.

PRODUCTION LEVELS IN SOUTH AFRICA

Canola is relatively new in South Africa. In 1994, only 500 t were produced, but it increased to 44 200 t on 40 200 ha during 2005. The production of canola in South Africa is usually lower than the demand and favourable prices could be achieved.

MAJOR PRODUCTION AREAS IN SOUTH AFRICA

Although canola is a summer crop in the temperate and cool areas of the world, it is mainly grown in the Western Cape Province as a winter crop. In the summer rainfall areas, canola can be produced under irrigation during the winter period.

DESCRIPTION OF THE PLANT

Roots

Canola has a taproot system. Growth is rapid after establishment with 85 % of the root dry matter in the top 25 cm of soil. Secondary roots grow laterally from the taproot.

Stems

Stem height varies between 75 and 175 cm with five to seven branches per plant. Secondary branches can also develop in the axils of bracts on the primary branches. Stems are important for photosynthesis. Widely spaced plants are usually branched extensively, which compensates for yield losses.

Leaves

Plants produce up to six large, waxy, blue-green leaves per stem. Leaf blades partially clasp the stem. After emergence, canola develops a thick rosette of leaves close to the ground before appearance of the flowering stem. The number Leaves on each main stem is between nine and 30.

Flowers

Canola has small, yellow flowers. Flowering commences on the main stem, which becomes the terminal inflorescence or raceme and proceeds acropetally, i.e. from the base towards the tip of the raceme.

Seeds and pods

Seeds are relatively small (280 000 to 340 000 seeds per kilogramme) and round black, brown or yellow. Mature pods contain about 23 seeds. Canola

pods develop firstly on the lower stem, and consecutive pods will form towards the top of the plant. Pods on the lower parts of plants are about 30 cm from the soil surface. Matured plants can reach 1,7 m in height, depending on the cultivar and growing conditions. Pods are prone to shattering if the harvest process is delayed.

CULTIVARS

A large spectrum of cultivars is available in South Africa. Days to flowering vary between 70 days for late planted (middle to end of June) and 120 days for early (May) planted crops. Plant diseases, growing length, yield potential and problem weeds are important aspects to consider when selecting cultivars.

Note that the cultivars may change annually because of ongoing research, therefore, cultivar choice should be revised annually.

Canola cultivars

44C11 (411)	Tornado 555 TT (1421)
44Y06 (411)	Varola 54 (1421)
45Y77 (411)	Varola 404 CL (1421)
AG-Muster (1)	Varola 405 TT (1421)
AG Spectrum (1)	Varola 600 TT (1421)
ATR-Banjo (1)	Phb 44C73 (411)
ATR-Cobbler (1)	Rocket CL (1421)
Hyola 61 (1421)	Thunder TT (1421)

CLIMATIC REQUIREMENTS

Temperature

Canola is produced in cool weather conditions with an optimum temperature for growth and production of 21 °C. Generally, temperatures below 10 °C result in progressively poorer germination and emergence. Low temperature impairs the production of sufficient protein that is required for proper germination and early seedling development. The maximum temperatures detrimental to seed production vary between 27 and 30 °C, depending on the cultivar.

Rainfall

In general, rainfall between April and October should be at least 300 mm for a yield of 2 t/ha. Yields can drop lower than 1 t/ha when rainfall is lower

than 200 mm. The most sensitive stages to drought are flowering and grain filling.

SOIL REQUIREMENTS

Canola grows on most soil types. It is best suited to clay-loam soils in which soil crusting is not a problem and which is not susceptible to wind erosion. Sandy soils should therefore be avoided, as these can also cause poor emergence. On soil with poor internal drainage, good surface drainage is essential, because canola cannot tolerate waterlogged soils. The ideal soil pH is between 5,5 and 7 (KCl).

Cultivation practices

SOIL PREPARATION

Canola seed is very small; therefore the seedbed should be fine without large clods to ensure an even planting depth. Emerging plants are very susceptible to soil crusting. Seed and soil moisture contact is critical for rapid emergence. Planting canola in dry soil is therefore not recommended. Seedlings are damaged easily by wind erosion.

PLANTING

Although there is variation, canola seed has an average of 250 000 seeds per kilogramme. Because of the small seed size, planting depth should be shallower than for most grain crops.

Planting density and spacing

Canola is typically seeded in 15 to 45-cm spaced rows under irrigation. Canola differs from most small grains because it cannot be planted when the top 5 to 7,5 cm of soil has dried out. Evenly spaced plants will optimise yields. Four to six kg of seed per ha (or 50 to 80 plants per aquare metre) should be planted. Three to four kg seed per ha can be used if the intended field is:

- relatively free of weeds or treated with a herbicide
- the seedbed is moist with little crusting potential
- the seed lot is vigorous

- seed placement is accurate and shallow with good seed-to-soil contact and a mechanical planter is used.

In situations of poor seedbed conditions, the seeding rate should be increased to more than 6 kg/ha.

Planting date

Canola should be planted in April to early June to achieve the highest yields. Significant yield reduction can be expected if planting is delayed until after 15 June. Canola is very susceptible to temperatures higher than 27 °C and drought stress during the flowering period. Planting in May will reduce the risk of heat and drought stress of the crop. Canola seedlings are tolerant to frost temperatures as low as –4 °C.

Planting depth

Canola should not be planted deeper than 3 cm; provided adequate moisture is present. The quicker seedling emergence assists the crop get ahead of or keep up with the weeds. Deep seeding delays crop emergence and results in weakened seedlings that are less competitive.

FERTILISATION

Canola is similar to small grains in its response to fertiliser and soil fertility. Nitrogen and sulphur applications are the key elements for canola yield improvement. Canola seed contains higher quantities of nitrogen, phosphorus, sulphur and potassium compared to wheat. Nutrients removed per ton of grain are shown in the following table.

Nutrients removed kg/t of canola grain and stubble				
Element	**Nitrogen**	**Phosphorus**	**Sulphur**	**Potassium**
Seed	15–40	4–7	2–10	08–10
Straw	04–10	2–4	3–12	25–31

Nitrogen

Canola has a relatively high consumption of nitrogen and about 55 kg N/ha is taken up by the crop to produce 1 t of seed per ha. High N fertiliser rates stimulate larger leaves, increase transpiration and moisture use. Under irrigation, the recommended N fertiliser rate is 180 kg/ha on clayey soils and 200 kg/ha on sandy soils.

Under dryland conditions, recommendations are made according to the production area. See information as compiled by the Western Cape Department of Agriculture in the following table.

Nitrogen recommendations for canola				
District and rainfall	Yield potential	Kg N/ha after (t/ha)		
		Lucerne	Legume crop or fallow	Grain stubble
Southern Cape (65 % winter rains)				
< 450 mm	1,0	10–20	10–35	45–50
450–500 mm	1,5	20–30	40–45	55–60
> 525 mm	2,0	40–50	50–55	65–70
Swartland (85 % winter rains)				
< 325 mm	1,0		50–60	60–70
350–425 mm	1,5		70–80	80–100
> 450 mm	2,0		90–100	100–120

For yield targets higher than 2 t/ha, the maximum N values should be increased by 30 kg/ha.

Nitrogen is very mobile in the plant. During a period of deficiency, nitrogen is transferred from older leaves to the younger growing tissue. N deficiency symptoms first appear on the older leaves. With severe deficiency, the oldest leaves and young plants are pale, with pink-coloured midribs and petioles. Later on, stems become dull red to purple red and the older leaves turn yellow to red orange

Phosphorus

The optimal P content of the topsoil should be 20 mg/kg (Bray 1 method of analysis). For lower or higher values, adjustments as shown in the following table should be made.

Phosphorus recommendations for canola		
Soil P status (mg/kg)		P recommendation (kg/ha)
Citric acid	Bray 1	
10 20 30	06 14 20	30 24 18

Phosphorus recommendations for canola		
Soil P status (mg/kg)		P recommendation (kg/ha)
Citric acid	Bray 1	
40 50+	28 34+	15 00

During the early plant development, a phosphorus deficiency will cause reduction in growth and dark-green leaves. Later, a distinct pink-purple colour develops on the tips and margins of the older leaves and develops shades of orange and red. The first symptom of P deficiency is puckering of the oldest leaves that are wilted with a dull sheen. A dull, yellow or yellow-brown colour develops at the tips of these leaves and gradually spreads toward the midrib, which stays green the longest. The condition progressively spreads to younger leaves.

Potassium (K)

The optimum K content of the topsoil is 80 mg/kg for clay soils and 60 mg/kg for sandy soils. K applications are seldom recommended as most soils have a high K status. Low values can be restored following the guidelines in the folllowing table.

Guidelines for Potassium (K) fertilisation	
Soil K content (mg/kg)	Recommended K rate kg/ha
< 50 50–80 > 80	40 20 0–20

The first symptom of K deficiency is a puckering of the oldest leaves with a dull sheen. A dull yellow or yellow-brown colour develops at the tips of these leaves and gradually spreads towards the midrib, which stays green longer. As the severity of K deficiency increases, the next leaf is affected to the same degree as the oldest leaf.

Sulphur

Canola has a relatively high sulphur demand, as many sulphur compounds are present in the vegetative parts and the seed. The sulphur requirement of canola is 15–20 kg/ha. Sulphur recommendations are shown in the following table.

Sulfur fertilisation guidelines	
Soil S content (mg/kg)	**Interpretation and recommendation**
< 6	Insufficient: S application higher than specific plant need (> 15–20 kg/ha)
7–12	Sufficient: S application enough for maintenance (15 kg/ha)
> 12	More than sufficient: S application less than maintenance (10 kg/ha)

If deficiency symptoms are present before flowering, yield responses are possible by applying ammonium sulphate. The earlier the treatment, the greater the yield response. Severe sulphur deficiency causes a marked inward rolling of the leaves. In some cases a pink-purple colour develops on the underside of the leaves. The most obvious symptom is severe mottling or chlorosis between the veins of the leaves.

Symptoms vary with the degree of deficiency. High nitrogen availability can exacerbates S deficiency symptoms in canola.

Other nutrients

Canola is susceptible to boron and molybdenum deficiencies, especially when Mo deficiencies are accompanied with low soil pH. Guidelines for the interpretation of a soil analyses are shown in two following tables. Copper, zinc, and manganese needs are higher compared to maize.

Guidelines for application of micronutrients of canola (mg/kg, EDTA soluble)

Nutrient	Insufficient	Marginal	Sufficient
Copper	0,3	0,3–0,5	> 0,5
Zinc pH < 5,5 pH > 5,5	 < 0,5 < 0,7	 0,5–0,7 0,7–1,0	 > 0,7 > 1,0
Manganese pH < 5,5 pH > 5,5	 < 05,0 < 10,0	 05,0–10,0 10,0–20,0	 > 10,0 > 20,0
Boron (warm water)	0,2–0,3	0,3–0,5	0,5

Recommendation for application rates of micronutrients		
Micronutrient	**Foliar application 500 liter water per ha**	**Soil applicationm per ha**
Zinc	1–2 kg zinc oxide	3,5–7 kg zinc oxide
Manganese	2–4 kg manganese sulphate	Ineffective
Boron	1–2 kg borax or 0,5–1,0 kg sodium borate (Solubor)	Not recommended
Copper	1–1,5 kg copper oxichloride	2,5–5,0 kg copper oxichloride
Molybdenum	100–150 g sodium or ammonium molybdate	250–500 g sodium or ammonium molybdate

Method and time of application

Nitrogen and potassium should not be applied in direct contact with the seeds. It should be broadcasted or applied in a band at least 5 cm away from the seed. Nitrogen fertilisation should be divided in 2 to 3 applications if possible. On heavier soils, 40 to 60 % can be applied during planting and the remaining 6 weeks after emergence (just before stem elongation). On sandier soils, 40 % should be applied during planting and 60 % in one or two equal applications. Sulphur should be applied with the nitrogen, especially on soils with a low pH. Other elements should be applied during or shortly before planting.

IRRIGATION

Most of the world's canola is grown under dryland conditions. Canola will suffer if water supply is limited. Experience has shown that yield will increase dramatically by irrigating at critical times under moderately favourable conditions. The most critical time for irrigation is during flowering and early pod development. Maximum oil accumulation occurs during the pod stage until pod maturation. Irrigation during this stage will maximise oil content. Water-use efficiency of canola is influenced by management factors and cultivar.

WEED CONTROL

Young canola seedlings are sensitive to weed competition. An effective weed control programme should include crop rotation, mechanical and chemical methods. However, once established, canola is a good competitor as its growth rate is higher than that of most weeds and weed control is seldom needed under irrigation in the summer rainfall area. If broadleaf

weeds pose a problem, triazine resistant cultivars can be planted. Canola is extremely sensitive to chemical drift from most broadleaf herbicides such as 2, 4-D, MCPA, dicamba, glyphosate, and certain sulfonylureas. Precautions should be taken to avoid the drift of herbicides to canola fields.

PEST CONTROL

Several insects can reach pest status on canola. The most important pests are black sand mite/redlegged earth mite (*Halotydeus destructor*), blue oat mite (*Penthaleus major*), cabbage aphid (*Brevicoryne brassicae*), lucerne earth flea (*Sminthurus viridis*), diamondback moth (*Plutella xylostella*) and bollworm (*Helicoverpa* spp.).

Black sand mite/redlegged earth mite and blue oat mite (April/May/June)

Adult black sand mites are about 1 mm long, with pear-shaped velvet-black bodies and red legs. Blue oat mites are about 1 mm long, dark green to black, with a red patch on the front and back, and red legs. Black sand mites feed on seedlings and cause silvery-white spots, especially along the main veins of leaves, which eventually become withered and discoloured. Blue oat mite causes a scorched appearance of the leaves. High infestations can cause substantial damage within a few days. Both species are serious pests of canola seedlings. Heavy infestations can reduce stand, retard growth and reduce yield. Quick-growing seedlings and adult plants can withstand moderate infestations.

Lucerne earth flea

These insects are very small, 1 to 2 mm long, greyish white, soft-bodied, wingless, with a strong, forked jumping organ attached to the underside of the abdomen. They characteristically jump into the air for considerable distances when disturbed. Lucerne fleas move up plants from ground level, eating tissue from the underside of foliage. This results in a finely speckled appearance of infested crops. Older nymphs feed through the leaves, creating typical windows in the leaves. Heavy infestations are frequent in fields where canola succeeds pastures.

Cabbage aphid (April to October)

Aphids migrate from host plant species and populations can increase quickly as a result of high temperatures. Cold weather conditions or good rains can reduce populations. Heavy infestations during flowering can

prevent the development of flowers. Heavy infestations after flowering can influence seed fill of pods negatively. It is important to control aphids during periods of moisture stress.

Diamondback moth (July to September)

Diamondback moth is a small moth with a diamond pattern on the closed wings. Light green larvae feed holes in the leaves. Feeding on pods causes damage to the surface only. Damaged pods tend to shatter more easily. Moths occur from the end of the stem elongation period, onwards. Infestations could occur earlier during warmer spells.

Bollworm (August to September)

The colour of the larvae varies from light green to dark brown. Small bollworm larvae are not injurious to canola, because they feed on the surface of pods and leaves only. Larger larvae (> 1 cm) tunnel into pods, leading to yield loss. Canola should be inspected regularly from the flowering stage onwards for infestations.

Other insects

Several soil insects, for example, cutworm and false wireworm can reduce plant stand.

DISEASE CONTROL

Rotations must be planned carefully to keep disease incidence and levels low. The two diseases of major economic importance are blackleg and *Sclerotinia* wilt.

Blackleg (*Leptosphaeria maculans*/*Phoma lingham*)

The blackleg fungus is spread by rain-splashed spores, wind-borne spores, and by infected seed. Varieties that have good tolerance or resistance to this disease are available. Spores land on the leaf surface of seedlings and then penetrate the leaf, causing lesions. Both the aggressive and non-aggressive form of the pathogen can cause lesions. The aggressive form of the blackleg pathogen travels through the leaf stem to the stem where it can cause lesions on and in the stem. These lesions cause rotting of the stem near the ground and impair transportation of nutrients to the pods. The plant then falls over and dies. In areas where the virulent strain of blackleg is present, crop rotation (4 year) and selection of resist-

ant varieties are important to blackleg management. All ramenas and wild mustard (host plants of blackleg) should be destroyed. If possible, plant as far away as possible from old infected fields.

Stem rot (*Sclerotinia sclerotiorum*)

Sclerotinia stem rot or white mould can be very destructive during periods of wet weather. The *Sclerotinia* fungus can survive up to 7 years in the soil and produces millions of airborne spores. Canola is primarily susceptible during all bloom stages and shortly after. Infections that start on the dead blossoms spread to adjacent tissue, resulting in dead branches or dead plants. The rotted stems usually have a bleached appearance. A minimum of a 4-year rotation is recommended for fields that have a history of *Sclerotinia* infestations. During this rotation, it is necessary to avoid planting highly susceptible crops, including sunflower, lupine and dry beans. Avoid contaminated seed. *Sclerotinia* is not poisonous to people or animals.

HARVESTING

Maturity and harvesting

Canola can be harvested directly with a combine harvester. Timing of this operation is of utmost importance to prevent losses and swathing is therefore recommended as a safer option. When at least half of the seed coat has turned yellow, brown or black, the seed is considered to have changed colour. Select pods from the middle section of the primary branch of canola plants that are representative of the majority of the crop.

Take at least 10 samples and four to five pods of each plant. Split the pods open and shell. Estimate the percentage colour change, when there is 40 % or more colour change the crop is ready to swath. When the crop is ready to swath, seed should be firm and not break when rolled between the thumb and forefinger.

The moisture content of seed for direct harvesting is about 35 %. If timely direct harvesting is not possible, harvesting is done through swathing, left to dry before combining. Canola is easy to cut but makes a bulky, fluffy swath that can be scattered quite easily by the wind. Swathing should be done just below the lowest seedpods, leaving the stubble as high as possible. This will allow the windrow to settle into the stubble and reduce loss from wind movements. To reduce shattering, use a belt-type pick-up attachment on the combine harvester. Combine cylinder speed for canola is reduced to about 50 to 75 % of that for wheat.

Avoid excessive cylinder speed, as it breaks up the straw, overloads the sieves and allows foreign material through with the seed. Canola straw and chaff should be spread behind the combine. Seal all openings off, because the canola seed is very small and round and it can flow like water through any opening. As soon as the moisture content of the seed drops below 8 % (5–14 days after swathing) it is ready for combining. Seed quality may decline if harvesting is delayed. If drying facilities are available, it can be harvested at higher moisture contents. The moisture content at harvesting has an important influence on the percentage loss during harvesting. Canola must preferably be harvested during the cooler time of the day, because it reduces shattering of the pods and therefore reduces seed loss. Avoid harvesting during warm, dry periods of the day.

Post-harvest handling

SORTING

Prior to processing, canola proceeds through a number of operations, depending on the cleaning requirements of the crop and include: fanning and sieving mills which remove blockage (foreign material such as pods, weed seeds, etc.); indent machines which eliminate seeds that are longer/bigger than the canola seed; destoners which remove dirt balls and small stones; and gravity tables which remove anything missed by other machines.

GRADING

The grading system allows canola shipments to be segregated into grades according to quality. Canola is being graded according to different grades, namely:

- Grade 1 should be reasonably well matured, sweet, of good natural colour.
- Grade 2 should be fairly well matured, sweet, of reasonably good natural colour.
- Grade 3 may have the natural odour associated with low-quality seed, but not distinctly sour, musty, rancid, nor having any odour that would indicate serious deterioration.

PACKING

Canola is packed according to different grades in sacks or bins. Packaging in wooden granaries does not facilitate control of seed leakage and provides access for the entrance of moisture, insects and rodents. Regardless of the construction material used, storage structures must be as weatherproof as possible, yet still allow easy access to the bin for sampling and monitoring. The weather proofing process must include the floors of bins that are set on concrete.

STORAGE

Stored canola differs from stored wheat because, unlike wheat, adverse changes can occur very rapidly. Canola seeds are more prone to deterioration in storage than cereal grains and must be stored at a lower moisture level to prevent moulding. Canola goes through a period of active respiration after binning, and if the heat and moisture is not quickly removed, mold growth and increased respiration soon occur. Seeds can be conditioned to avoid spoilage in storage, to extend the harvest season, and to reduce field losses. Conditioning systems using aeration, natural-air drying or heated-air drying or a combination of these, can ensure safe storage. Going from cereal grains to canola during drying operations requires temperature readjustment because reduced airflows increase drying times and the possibility of unsafe temperature buildup. Canola can be stored readily for long periods of time at moisture levels of 8 to 9 % if seed temperatures are below 20 °C and insect and mite infestations are not present.

TRANSPORT

Canola can be transported by rail and road trucks, air flights as well as ships. During transportation all cracks and holes in the truck and other equipment must be sealed compactly to prevent leakage and covered tightly to prevent canola seeds from being blown away.

MARKETING

Canola competes with other plant oils, mainly sunflower and soya oils, on the local market. South Africa is a net importer of plant oils. The domestic demand for plant oils is estimated at 720 000 tons per year. Approximately 300 000 to 350 000 tons of plant oils are produced in South Africa and the balance is imported, primarily as sunflower oil and soya oil. The biggest sales point for canola in the Western Cape is the industrial market because of its good emulsifying characteristics.

The market for bottled canola oil has room for growth because it is not well known among consumers. It is also fairly unknown in the industrial deep-frying market.

Production schedules

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling												
Soil preparation												
Planting												
Fertilisation												
Irrigation												
Pest control												
Disease control												
Weed control												
Leaf sampling												
Harvesting												
Marketing												

Utilisation

Canola has many uses, both edible and inedible. It can be utilised for human consumption as canola oil or can be blended with other vegetable oils for the production of various solid and liquid cooking oils and for salad dressings. Canola meal can be used in animal feeding; it is recommended for up to 10 to 20 % of the ration for chickens, turkeys, and ducks; dairy and beef animals. The meal is a good source of protein in the animal feed and is a high-quality organic fertiliser which can be used by commercial organic farmers. Canola is also used in the industrial market because of its good emulsifying characteristics such as in biodiesel production. It is also an excellent insect repellent.

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