

# Coriander -



Coriander is an annual herb that belongs to the carrot family - Umbelliferae. Its name is derived from the Greek Koris, meaning bedbug, because of the unpleasant, fetid, bug-like odour of the green herb and unripened fruits. Coriander is a native of the Mediterranean region. It is one of the earliest spices used by mankind. Today it is grown extensively in India, the Soviet States, central Europe, Asia, Morocco, and South and Western Australia.

The coriander plant yields two primary products that are used for flavouring purposes: the fresh green herb and the spice. The latter is the dried form of the whole mature seed capsule (fruit) but is frequently termed 'coriander seed' in commerce. The odour and flavour of these two products are markedly different. The herb is used for culinary flavouring purposes in Asia, the Middle East, and Central and South America. The fruits are an important ingredient of curry powder. They are used as a pickling spice, in seasonings and sausages and also in pastries, buns, cakes and other confectionary. Coriander oil is used to flavour alcoholic beverages, candies, meat, sauces and tobacco. The fruits and oil are used to cover the taste or correct the nauseating or griping qualities of other medicines. They are used medicinally for a number of purposes, particularly to relieve flatulence.

In commerce, coriander is broadly divided into two types according to the size of the fruit. Fruit size is an indication of volatile oil content and suitability for particular end uses. Variety vulgare or macrocarpum has a fruit

diameter of 3-5 mm while var. microcarpum fruits have a diameter of 1.5-3 mm. Large fruited types are grown mainly by tropical and subtropical countries, e.g. Morocco, India and Australia and contain a low volatile oil content (0.1-0.4%). They are used extensively for grinding and blending purposes in the spice trade. Types with smaller fruit are produced in temperate regions and usually have a volatile oil content of around 0.4-1.8%, and are therefore highly valued as a raw material for the preparation of essential oil.

Coriander is an annual. It is erect and has a tap root. The flowering stem, which is slender and smooth, reaches a height of 20-120 cm. The flower, in compound umbels, bears small white or pink flowers that bloom in January to February. Hermaphrodite and staminate flowers may occur in each umbel. The fruits are nearly globular, 3-4 mm in diameter, and are yellow-brown when ripe. The fruits consist of two halves - single-seeded mericarps. The unripe fruits smell of bedbugs, but become pleasantly aromatic on ripening.

## Crop production

Coriander is always propagated from seed. Often, before sowing, fruits are rubbed until the two mericarps are separated. A clean and reasonably fine seedbed is required. The plant is not sensitive to cold and is quite resistant to heat and drought. Crop management and requirements are similar to other broad acre crops e.g. rape seed oil crop. Yields are best on free draining soils where there is adequate moisture during the vegetative phase of the crop. The seedling is relatively slow to develop and weed control is important during establishment. Reproductive stem growth is very rapid and competitive against weeds. Heavy rain during the period of stem extension can be hazardous, resulting in lodging and breaking off of the soft fleshy reproductive stem. Seed is sown at a seeding rate of 5-30 kg/ha. Lighter seeding rates produce large, more robust plants but the period of flowering and fruit development is spread over a longer period. High seeding rates results in fewer umbel classes being produced but a far greater risk of crop lodging. Seed is drilled with a grain drill at 20-30 mm depth and drill rows are 15-30 cm apart.

No chemicals are registered for use on the crop in New Zealand, therefore, no recommendations for chemical controls can be made. Overseas literature and experience in New Zealand suggests that the crop shows similar tolerances to those agricultural chemicals applied in commercial carrot production.

Results from field trials at six contrasting environmental sites in Otago and Southland show considerable variation in yield of dried fruit and essential oil (Table 1). In agreement with overseas literature, the yield of dried fruit and oil was higher from the microcarpum-type than the vulgare seed type. The microcarpum seed type required between 100 and 140 days growing season and ranged in height from 80 to 150 cm, whereas the vulgare seed type matured earlier,

75-90 days, and ranged in height from 20 to 50 cm. Essential oil production is probably only viable based on the microcarpum seed types.

Plant diseases, and in particular *Pseudomonas* sp. (flower blight), has been identified from these trials as a major factor limiting the further development of this crop. The primary source of infection is thought to be from seed infection. The pathogen causes lesions on the inflorescence and fruit (schizocarp) that in severe cases result in the death of an infected umbel. Blemishes on the mericarp of the fruit down grade its quality for spice use, and reduce its use as seed since the blemishes provide infection sites. Disease control strategies are currently under investigation. At present, there appears to be no effective chemical control. Disease severity is greater under spray irrigation. Environmental conditions also influence the severity of the disease.

Flowering and fruit maturity of coriander is indeterminate making it difficult to identify the most appropriate time to harvest and the method of harvest. Delaying harvest to allow umbels that are slow to form to reach maturity can result in fruits on the primary umbel shattering. Seed shatter and loss of a complete class of umbel can occur within a period of a few days under windy conditions. Results of previous trials indicate that the primary umbel can make up 10-30%, and the secondary umbel 50% of the total yield (at sowing rates of 30 fruits/m of drill). If the crop is desiccated or windrowed both methods can result in a significant loss of yield if the weather conditions are unfavourable for any length of time after desiccation or windrowing has been carried out.

Air frosts of 1-2°C can completely destroy the crop during the flowering, fruit filling period. This has been a problem in cool and adverse seasons with microcarpum seed types.

*Table 1: Yield of dried fruits and essential oils from coriander grown at six environmentally contrasting sites in Otago and Southland.*

Sites	Vulgare		Microcarpum	
	Fruit yield (kg/ha)	Oil yield (l/ha)	Fruit yield (kg/ha)	Oil yield (l/ha)
Oamaru	950	2.42	1380	8.45
Invermay	1210	2.60	1680	9.95
Winton	1780	5.50	2100	18.84
Woodlands	1200	3.89	1910	16.16
Lumsden	660	2.19	1580	12.77
Redbank	1460	4.06	750	5.28
Ranfurlly	624	1.72	966	4.68

## Spice quality

The size, volatile oil content and aroma/flavour character of dried, mature fruit are principally governed by the intrinsic properties of the cultivar grown. The stage of maturity of the fruit at harvest is also of paramount importance in determining the quality of the spice. Immature fruits contain a higher volatile oil content than ripe fruits, but the aroma of the immature fruits is generally considered to be disagreeable by consumers in Western countries. The characteristic, sweet and spicy aroma of the spice does not develop until the fruit has attained maturity and commences to dehydrate on the plant. So it is important to harvest the fruit at the right stage. Since fruit ripening on the plant is not simultaneous but progressive, judgement is required to decide on the optimum time for harvesting - normally when a fair proportion of the fruits on an umbel have changed colour from green to grey-green or yellow.

Over-ripening of the fruits on the plant should be avoided or yield is reduced. If the fruits are allowed to become too ripe there is a distinct risk of shattering during harvesting and post harvest handling. Splitting of fruits is undesirable for two reasons: firstly, it spoils the appearance of the whole spice, and secondly, it can lead to considerable loss of the volatile oil during subsequent storage.

At harvest, the moisture content of the fruits may be greater than 20% and it must be reduced to 9% or less during drying. If the fruits are not thoroughly dried they absorb heat very readily resulting in deterioration of both the colour and flavour of the spice.

Cleanliness of the product is important in the marketing of this spice. Fruits should be thoroughly cleaned to remove extraneous matter such as stalks, plant debris and soil.

## Essential oil

Coriander oil is prepared by steam distillation of mature, dried fruits. Distillation of the oil is hindered by the fact that the oil cells are located within the mericarp of the spice, which are protected by a thick cell wall, and also by the high fat content, which tends to occlude the volatile oil and reduce the vapour pressure. To obtain the maximum yield of essential oil and to reduce the processing time, it is necessary to crush the spice prior to distillation. Overheating of the spice during the crushing operation and undue delay when loading the crushed material into the still must be avoided since volatile oil loss by evaporation can readily occur.

The former USSR is the largest producer of coriander oil. In 1985, oil production from the former USSR often exceeded 100t/year. Continuous distillation equipment replaced the conventional types of still operated on the

batch system. The residues from continuous distillation are processed for their fatty oil by being first milled and then extracted with solvent to yield 17-18% fatty oil. The current spot market price for coriander oil is around \$US 42/lb. However, the value of any oil is entirely dependent on its odour and flavour characteristics and the quantity available.

Variations have been noted in the literature between the odour characters of oils from different types and sources of the spice. Moroccan and Indian coriander oils are generally regarded as inferior in odour quality to European spice oils.

The composition of the volatile oil, which determines the odour and flavour character, has been of particular fascination to chemists. In the unripe fruit and herb, aliphatic aldehydes predominate in the steam volatile oil and are responsible for the peculiar, fetid-like aroma (an important flavour component of Thai cuisine). On ripening, the fruits acquire a more pleasant and sweet odour and the major constituent of the volatile oil is the monoterpene alcohol, linalool. In the unripe fruit, two types of volatile oil canals are present. One type is located on the periphery of the fruit and these canals contain a volatile oil comprised predominantly of aldehydes. The second type of canals is buried in the mericarp of the fruit kernel and the composition of their volatile oil is very different. The major component is linalool together with some other oxygenated monoterpenes and monoterpene hydrocarbons. As the fruit ripens on the plant, the peripheral canals flatten, begin to lose their volatile oil, and the odour of the fruit changes. On drying to around 7% moisture content, the outer canals completely lose their volatile oil but the inner canals remain intact and the characteristic odour and composition of the volatile oil of the spice are attained.

The essential oil obtained through steam distillation of the fruit is a colourless or pale-yellow liquid. The aroma has been described as pleasant, sweet and somewhat woody and spicy, with a floral-balsamic undertone and peppery-woody topnote as the characteristic features. The flavour is described as mild, sweet and spicy-aromatic yet somewhat warm and slightly burning. In depth analyses of the oil have identified 203 individual components in coriander fruit oil. The 18 main components constitute 97% of the total oil without giving the odour impression of coriander oil when reconstituted in the concentrations found in the natural sample. Therefore a major sensory effect of the oil comes from the 180 trace components that occur, on average, in concentrations of about 0.01% or less. The inclusion of unripe fruits or other over-ground parts of the plant during distillation of the fruit imparts an obnoxious odour to the oil. The organoleptic properties of the distilled oil tend to deteriorate during prolonged storage especially if left exposed to light and air.

## **Production, trade and markets**

In addition to the spice, considerable quantities of the fresh, green herb are consumed domestically in Asia, the Middle East, and Central and South America. Interest is increasing amongst commercial food processors in using the herb oil to flavour ethnic food.

India is probably the largest producer of fresh, green coriander although most of it is produced for the domestic market. Production in Europe and Eastern Europe is substantial. In Soviet States coriander is grown mainly for the production of the essential oil. Probably the largest consumer in the Economic Community is Germany. Imports of coriander into New Zealand for spice seed are only around 40-60 t/year at approximately \$0.90 per kg. Domestic production could, therefore, be supplied by one, moderately sized producer.

In Western Europe, Asia, North America and the Middle East, coriander trade appears to enter the international trade through the same distribution channels as other spices. Trade involves an exporter, an agent-broker and occasionally a dealer. The smaller fruited cultivars produced in Europe, exemplified by Russian coriander, have a far greater volatile oil content and flavour strength than the larger fruited types and fetch higher prices in the market.

## **Prospects for the future**

Currently, the greatest risk to coriander production for oil or the spice are crop diseases for which there is little published information available and currently no proven control strategy.

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