New Zealand Institute for Crop & Food Research Ltd
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CROP & FOOD RESEARCH
Mana Kai Rangahau

Growing licorice

Glycyrrhiza glabra L., *G. uralensis* Fisch., Family: Fabaceae (Leguminosae)

Introduction

Licorice, or alternately liquorice, is derived from the sweet root of various species of *Glycyrrhiza*. Black licorice extract is obtained by boiling or diffusing the shredded roots and rhizomes of licorice plants in water, and then concentrating the extract in evaporators. The root extract contains 6-8% of glycyrrizin (a saponin glycoside which is about 50 times sweeter than cane sugar), triterpenoid acids, flavonoid glycosides, glucose, sucrose and starch. The generic name, *Glycyrrhiza,* comes from the Greek *glukus* meaning sweet and *rhiza* meaning root. In the medicinal herb trade the dried root is known as Radix Glycyrrhizae. The black extract is widely used as a herbal medicine, in confectionery, beverages and tobacco products, and as a flavouring to mask the unpleasant taste of some medicines.

The medicinal properties of licorice have been recognised for thousands of years, and the root and root extract were used in ancient China, India, Egypt, Greece and Rome. Today licorice is used in the treatment of sore throats, coughs and bronchial catarrh, gastric and duodenal ulcers, allergic reactions, rheumatism, arthritis and tuberculosis. It is one of the most important Chinese medicinal herbs, occurring in two-thirds of Chinese therapeutic formulas. On the other hand, large doses of licorice (more than 50 g a day) over an extended period can increase potassium excretion and sodium retention, which increases water accumulation in the body, causing swelling of the hands and feet and a possible rise in blood pressure.

The 'licorice' flavour in some confectionery is derived from the herb anise (*Pimpinella anisum)* rather than from licorice root.

The plant

There are more than a dozen *Glycyrrhiza* species spread through southern Europe, Asia and the Americas. The two most commonly grown species are European licorice (*Glycyrrhiza glabra* L.) and the Chinese species (*G. uralensis* Fisch.).

European licorice is a perennial, spreading, deciduous, woody herb that grows to a height of 1.5 m. The plant has dark green leaflets which make up the compound leaves, and produces spikes of small, pale blue, pea-like flowers in summer. The top growth is frost tender and dies down in winter, regrowing in the spring from the underground plant crown and rhizomes. The plant develops long thin vertical roots to a depth of over 1 m, and horizontal, creeping rhizomes that continuously expand outwards from the original crown. These rhizomes then produce new shoots, at times many metres from the original plant. Both roots and rhizomes are yellow inside and are sweet and juicy. European licorice is native to the Mediterranean countries and south-west Asia.

Typically the plant prefers deep sandy soils and warm temperatures for growth, but because it is deciduous it has adapted to a wide range of climates with annual rainfall varying from 300 to 1100 mm. In Spain, licorice is considered best suited to the mild areas where oranges also grow, but licorice was also grown successfully in Yorkshire in England for 300 years, indicating that it should be hardy enough to grow in most regions of New Zealand.

The hardy Chinese licorice is a native of Northern China, Mongolia and Siberia. It has a similar growth form to European licorice, but has hairy leaves and purple flowers.

Production

European licorice root is produced commercially in the countries surrounding the Mediterranean, and in southern Europe and India. Chinese licorice is grown in China, Mongolia and Siberia.

Field trials in New Zealand—in Central Otago, Canterbury, Hawke's Bay and the Waikato on free draining, friable, silt and sandy loams—have shown that both European and Chinese licorice could be grown successfully in most cropping areas of New Zealand. The important requirement is a free draining friable soil with good fertility and a pH between 6 and 7.

Plant propagation

Licorice plants can be raised from seed or from root cuttings. Seed of both European and Chinese licorice can be obtained from international seed merchants such as Richters **(www.richters.com)** in Canada and can be imported into New Zealand provided basic quarantine requirements are met. Seedlings are usually raised in greenhouse trays or cells and then transplanted into the field in spring. Root cuttings are usually used to establish commercial crops. They are cut from rhizomes taken from mature plants in winter when the plant is dormant. The rhizomes are stored in cool, moist conditions to prevent them drying out and then cut into 150 mm lengths, with two or three buds, for planting directly in the field.

Crop establishment

The production site should be free of perennial weeds. It is essential to control weeds before establishing the crop as it will be in the ground for several years. Seek advice on which herbicides should be used to kill problem weeds (unless organic production is planned). Cultivate the soil well and apply lime to ensure a pH above 6.0. If a soil test shows that nutrient levels are low, apply a basal fertiliser to obtain medium soil levels of P, S and K. There is no evidence that licorice benefits from high levels of nutrients.

As mentioned above, the crop can be established by using seedling cell transplants or root cuttings. Crop & Food Research field trials were established by lying the root cuttings horizontally in 100 mm deep furrows and then covering them with soil to leave a flat soil surface. Overseas, licorice is sometimes established on ridges. This may provide some advantage at harvest but it makes it difficult to use mulching mowers for the annual winter clean-up of dead top growth.

The crop is commonly grown overseas in rows 70-100 cm apart with a 40-60 cm space between individual plants. This layout need not be strictly followed as the plants will spread into the gaps as they grow. A research trial showed that root yield increased markedly when plant spacing was tightened from 1 x 1 m to 0.25 x 0.25 m spacing. An added advantage of closer planting is that the top growth of the crop helps control weed growth.

Under dry spring conditions irrigation can help to establish the crop, but once established licorice is drought tolerant and does not usually need more water unless conditions are exceptionally dry.

Crop management

After establishment, the crop usually requires minimal management until it is harvested 2 - 4 years later. The major requirement is weed control. Trials in the Hawke's Bay indicated that licorice is tolerant of a wide range of herbicides. Trifluralin can be soil incorporated before planting. Chlorpropham plus diuron, cyanazine and metribuzin are recommended for pre-emergent application after planting root cuttings; bentazone and metribuzin are suitable for post-emergent application. All chemicals should be used at label rates. ***Note:*** *none of these herbicides have label recommendations for use on licorice so they are used at the grower's risk.* The herbicides do not control weeds for the whole season, but once the licorice is growing vigorously by early summer it should suppress further weed growth. During winter when the crop is dormant, the dead top growth can be mown and mulched, and contact herbicides used to clean up the beds before spring emergence. Organic growers can control weeds with sawdust or straw mulches.

The excavated root system of a licorice plant.

New Zealand licorice trials have been almost free from diseases and pests. One disease found under the wetter environmental conditions of the Waikato was leaf spot (*Phoma medicaginis)* which can be controlled with fungicides such as Benlate (benomyl), Alto (cyproconazole) or Octave (prochloraz).

Harvesting

Licorice roots are traditionally harvested after 3 or 4 years' plant growth. Results of New Zealand trials suggest that good root yields can be obtained after 2 years although the differences in profitability from harvesting in either year 2, 3 or 4 have not been assessed. Overseas, licorice roots are apparently harvested from the top metre of soil by deep ploughing or trenching and hand harvesting. The New Zealand trials have shown that nearly 80% of the root mass occurs in the top 30 cm of soil, although as crops get older the percentage of roots in the top soil decreases. This suggests that there is little point in harvesting roots below 30-40 cm which means that mechanical harvesting should be feasible. After harvesting the crop usually re-establishes itself from the remains of the roots left in the soil. This ability to regenerate from root remains means that licorice has the potential to become a weed in following crops.

Root yields

Commercial licorice crops in Italy typically yield 15 t/ha of fresh roots after 3 years growth with higher yields expected where irrigation is applied. In other countries, fresh root yields vary from 10 t/ha to as high as 50 t/ha—recorded where exhaustive harvesting was carried out. Yields from New Zealand trials have varied from 12 to 25 t/ha in the second year of production to 34 t/ha after the crop was grown for 4 years and harvested down to 90 cm. These yields indicate that licorice root can be grown successfully in New Zealand with yields comparable to those reported overseas. The dry matter content of New Zealand-grown roots has been between 40 and 50% with the glycyrrhizin content varying from 1.3 to 7.1% from different sites in different years. Most values were between 2.5 and 5.0%, which is within the range reported overseas.

Processing

Licorice root is marketed in two main forms: peeled or unpeeled dried roots, or chipped and shredded root. The roots are dried either by slow air drying or in low temperature ovens. Our research has shown that the root can be dried at temperatures of up to 65°C without degrading the glycyrrhizin. Licorice root has to meet defined quality specifications for sale. Tests are carried out to assess glycyrrhizin content as well as levels of soil and microbial contamination, pesticide residues, heavy metals, and radioactivity.

Hot water is used to extract licorice from the green or dried roots. The licorice extract then passes through several evaporators to be concentrated before it is machine moulded. The extract is sold in either a solid or powder form after being granulated or spray dried. It is sometimes mixed with wheat flour to produce extruded licorice or licorice paste.

Licorice confectionery (left) and harvetsed licorice roots (right).

Liquid licorice extract should contain 4.5 - 6% glycyrrhizin, and solid licorice extract should contain not less than 6% glycyrrhizin. For medicinal use the licorice must meet the standards of the appropriate pharmacopoeia. Chinese licorice has similar levels of glycyrrhizin to European licorice but little or no sugars, so it has a more bitter, pungent flavour than European licorice.

Uses

Modern studies have shown that licorice extract has anti-inflammatory, anti-viral, anti-allergenic, anti-ulcer, and anti-oxidative properties as well as exhibiting anti-cancer and anti-hepatotoxic activity. Licorice is widely used in food products from cakes to confectionery, especially in Europe. It is used in the production of beers and spirits, both for flavour and to improve foam stabilisation or head forming characteristics in beers. Although licorice is a significant product in the medicinal and confectionery industries, 90% of the licorice imported into the USA is used in the tobacco industry to flavour tobacco products such as cigarettes, pipe tobaccos and, ironically, anti-smoking preparations. The boiled root mass left over after the licorice extraction process has been used overseas to make insulation board or as a substrate for mushroom culture.

Prospects

There is considerable international trade in licorice. World production averages 30 000 - 40 000 tonnes per annum. Both the UK and USA import 16 000-17 000 t annually in various forms, and Japan imports about 6000 t of roots and 1400 t of extract.

In New Zealand, licorice is purchased by the confectionery trade as a spray-dried powder with a minimum content of 21% glycyrrhizin. The present price varies between NZ$8 and NZ$11/kg for this product, but it is higher for pharmaceutical grades.

The most likely market for New Zealand-grown licorice is to supply high quality extract to the local food and medicinal industry and for export. There has been no economic analysis of the likely competitiveness of New Zealand produced licorice on the international market but it is likely that New Zealand growers and processors will have a greater opportunity to compete profitably by marketing high quality extract than by supplying the commodity trade of licorice root.

Additional reading

Martin, R.J., Douglas, M.H., Heaney, A.J. 1997. Yield and root distribution in a commercial licorice crop. *In:* New crops, new products, new opportunities for Australian

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