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CROP & FOOD RESEARCH
Mana Kai Rangahau

Echinacea - The purple coneflowers

Echinacea, which belongs to the daisy family Asteraceae (Compositae), is commonly known as the 'purple coneflower'. The whole plant, but specifically the roots of *Echinacea,* is highly regarded as a non-specific stimulant of the immune system, as an anti-flammatory and as an aid in wound healing

Echinacea angustifolia (narrow-leaved purple coneflower)
Echinacea pallida (pale purple coneflower)
Echinacea purpurea (purple coneflower)

In the past, the coneflowers have been listed in both the Brauneria and Rudbeckia genera. There are nine species endemic to the prairie lands of North America but only two have been actively commercialised. Echinacea are perennial herbs that, in a young vegetative state, produce a cluster of leaves to about 30 cm high from a short (20-30 mm) rhizome. *E. angustifolia* has stiff, bristly hairs on its leaves, and is tap-rooted, while the more robust *E. purpurea* has glabrous leaves and fibrous roots. There is a difference in leaf shape between species *E. angustifolia* has linear-lanceolate entire leaves 5-30 cm long, while E. *purpurea* has larger, ovate, coarsely-toothed leaves. In its first year of growth, one or more flowering stems are produced, which grow up to 1.5 m high and bear the large (5-15 cm) ray flowers. A characteristic is the conically-arched seed head that, in *Echinacea,* is spiny, and the generic name is derived from the Greek word "rhinos" meaning hedgehog. The flower stems and most of the leaves die off during the winter, but produce numerous short, lateral rhizomes from the base of the stem, each developing into more flowering stems in the second and subsequent years of growth.

Uses

The dried root and rhizome of *E. angustifolia* and E. *purpurea ea* are the major product used while the leaves are also harvested and extracted.

The whole plant, but specifically the roots of *Echinacea,* is highly regarded as a non-specific stimulant of the immune system, as an anti-inflammatory and as an aid in wound healing. Traditionally, it was highly valued as a remedy against various types of infections, in treating poisonous bites of snakes and insects, as a palliative agent in malignant conditions and for its wound-healing properties. It is now particularly used to increase resistance to infections.

Historically, *Echinacea* was one of the most important plants used medicinally by the North American Indians. Widespread pharmaceutical recognition was initiated in the second half of the nineteenth century when a wonder cure "Meyer's Blood Purifier" based on *E. angustifolia was* marketed. *Echinacea* tincture became a very popular herbal remedy and, by 1916, the roots of *E. angustifolia* and *E. pallida* were made official drugs and remained in the National Formulary of the USA until 1950.

In Europe, *Echinacea* did not achieve general recognition as a medicinal plant until the turn of the century. In subsequent years, *Echinacea*, specifically E. angustifolia, became especially important in homeopathy. During the 1930s, seed of *E. angustifolia* could not be obtained and *E. purpurea* was introduced to Europe where it subsequently achieved equal status with *E. angustifolia*. *Echinacea* was extensively researched in Germany in the 1950s, where it now has a well established place in mainstream medicine - more than 250 products containing *Echinacea* are available.

Many chemical components have been identified from *Echinacea* extracts. The immunostimulatory effects of *Echinacea* preparations have, at various times, been attributed to echinacoside (a caffeic acid derivative), polysaccharides, and alkylamides. The latter compounds are responsible for the tingling sensation produced on the tip of the tongue by *Echinacea*, especially *E. angustifolia* root.

Agronomy

The *Echinacea* are drought- and frost-tolerant. *E. purpurea* grows naturally in open woods and prairies in the mid-West and Eastern USA. The more tap-rooted *E. angustifolia* is present across the Great Plains on the dry upland prairies that are often rocky. *E. purpurea* has been grown successfully throughout New Zealand in Crop & Food Research trials while trial plots of E. *angustifolia* have been grown in Central Otago, in coastal Otago, and in the Nelson district.

The *Echinacea* are lime-loving plants and grow best on fertile, free-draining loams. In their natural range in North America, coneflowers grow in soils with a pH ranging between 6 and 8, with *E. angustifolia,* typically found on lime-rich soils. However, *E. purpurea* has been grown and produces well in New Zealand on soils of pH 5.5-6.0. In Germany, light, friable and peat soils are recommended. The soil texture is important, and a soil that can easily be washed from roots is desirable.

German growers apply 100-200 kg/ha of nitrogen in split applications during the life of the crop, and as much as 100 kg of phosphorus and 250 kg of potassium at planting. Trials assessing the effect of soil pH and fertiliser response under New Zealand conditions are being conducted by Crop & Food Research. In general, a fertiliser containing NPKS in a ratio of 15:10:10:8, applied at 500 kg/ha, should be adequate initial nutrition tied to a follow-up dressing of nitrogen. Lime to bring the soil above pH 6.0 seems warranted.

It is recommended that crop establishment takes place in the spring. Transplanting E. *purpurea* seedlings is recommended because germination of seed in the field can be erratic. Bare-rooted seedlings of E. *angustifolia,* which are tap-rooted, often do not survive transplanting, and cell transplants are recommended.

American experience suggests seed may need up to two to three months, in cool and moist conditions, to break dormancy. However, European seed used in New Zealand trials showed no requirement for chilling, with 80-90%, germination within three to five weeks of sowing. In the USA, seed is sown or planted in rows 30-40 cm apart, with 30 cm between plants on beds or ridges. This spacing represents a plant density of 8-11 plants/m^2, but a Crop & Food Research density trial with *E. purpurea* has shown yield gains from planting densities as high as 25 plants/m^2. Work is continuing to define optimum planting densities.

Good weed control is essential to achieve acceptable yields of *Echinacea.* A direct-seeded crop is slow to establish in the field so competition from weeds must be overcome, and techniques such as pre-sow spraying or planting into a stale seedbed should be undertaken.

No herbicides are registered for use on *Echinacea* in New Zealand. Preliminary trials indicate that *E. purpurea* seedlings tolerated pendimethalin (Stomp 330E), oryzalin (Surflan flo), and a combination of oryzalin and chlorpropham (Surflan flo / Chloro-ipc) at planting, and also terbacil (Sinbar), diuron (Direx or Karmex), and chlorpropham (Chloro-ipc) when plants are established.

Weed control in *Echinacea is* more time consuming without the use of herbicides. Mechanical weeding or the use of mulches would be useful techniques. Although non-chemical weed control is ultimately desirable it is not feasible to grow *Echinacea* on a large scale in New Zealand without some herbicide assistance.

Pests and diseases

No significant root diseases or pests were recorded in two years of New Zealand-wide trials, but cucumber mosaic virus has been noted to cause yellow mottling on leaves. Severe leaf distortion in some South Island trial sites appears to be a direct reaction to aphid leaf feeding since no aphid-borne viruses were detected in affected leaves. Aphid control on young plants is, therefore, advisable.

Harvest

Plants are harvested in autumn. Tops are cut to about 5 cm above ground level before plants are lifted using a digger that can work to a depth of 30 cm. Shoot residue must be removed before roots are cut into 5-10 cm long pieces and thoroughly washed. The fibrous-rooted *E. purpurea* is more difficult to clean than the tap-rooted *E. angustifolia.* Clean roots are essential to meet quality standards. Choosing a friable soil with relatively low clay content can make a substantial difference to the ease of root washing. After washing, the roots, which are about 30-35% dry matter, are dried at 40-45EC until brittle. In Germany, both *E. angustifolia and E. purpurea* yield 2-3 t/ha of dried root in the first year and up to 6 t/ha after two years. In a production trial (Dec. 1991 - May 1993) at five New Zealand sites, *E. purpurea* produced 1.3-2.6 t/ha of dried root. This was from a crop planted at the relatively low density of 5.6 plants /m^2. In a preliminary experiment under irrigation at Redbank Research Station, the effect of crop density on production was studied. E. *purpurea* was planted at three densities 6.25 plant/m^2 (40 cm x 40 cm), 12.5 plants/m^2 (20 cm x 40 cm), and 25 plants/m^2 (20 cm x 20 cm). The high density plots produced greater fresh and dry root yields than the lower density plots, and double the German production. The plots planted in December 1990 produced 7 t/ha by April 1992 and 13 t/ha by April 1993.

In Germany, the production of foliage is an additional crop and harvesting is undertaken by mowing the plants at 10 cm above the ground. Their yields for *E. angustifolia* are 3 t/ha of dried leaf in the first year and up to 10 t/ha in the second year. The leaf production from *E. purpurea* is higher with 7 t/ha in the first year and up to 14 t/ha in the second year.

There are no New Zealand data to provide a comparison.

Quality

There are a number of quantitative standards for *Echinacea* root. A maximum water content of about 10%, a total ash content up to 9%, and not more than 3% of foreign matter are typically specified in pharmacopoeia. However, apart from these gross physical determinants of quality, there appear to be no widely accepted quality criteria relating to chemical content. Crop & Food Research's Plant Extracts Research Unit has developed a quality test, analysing for the alkylamides, which will allow comparative studies to be undertaken. One of the problems facing European Community countries in their attempts to produce a uniform set of standards for phytomedicines traded in the community is that many countries have their own set of assessment criteria and are not prepared to accept products from other countries that have been assessed using different criteria.

Market

The largest market for herbal medicines using *Echinacea* is in Europe, where Phytomedicine counter sales were US$2.4 billion in the European community in 1990, 65% of this total in Germany. The volume of world trade in *Echinacea* root is not known. There is a small demand by Australasian processors for root (a few tonnes only).

Prices paid for dried root typically range from $20 to $60/kg depending on the degree of processing. The price for leaf is in the $8-25 range. Growers will need to identify major buyers and determine their requirements before large scale production is considered. Although attempts to produce uniform standards for Europe have begun, it is likely to be some time before they are established. Because most phytomedicine markets in European countries are dominated by local brands, with very few brands crossing national boundaries, suppliers to these markets must pay particular attention to the specific requirements of the individual market for which the product is destined. Supply contracts should be sought, and trial shipments made to the target market.

Seed sources

Anon, 1992: The New Zealand nursery register 1992/93. Reference Publishing Co., Auckland, New Zealand.

Philip, C. (ed. Lord, T.) 1991: The plant finder 1991/92 Edition. Headmain Ltd. UK.

Issacson, R.T. 1989: Andersen Horticultural Library's source list of plants and seeds. Andersen Horticultural Library, University of Minnesota, USA.

Seed costs of around $250-1200/kg are typical depending on the species sought. The thousand seed weight of Echinacea is about 3.3 g but may vary from 2.5 g to 5 g.

Future

As a priority, Crop & Food Research is setting up an analytical test of Echinacea quality to enable comparative crop and processing tests to be undertaken. Important questions relating to cultivar selection, the effects of soil pH, fertiliser and planting density on yield, and the effect of drying and storage conditions on chemical composition of the root have not been addressed. Perhaps most important is work to identify the quality standards used by major traders in the crop. There is now a need to get commercial volume onto the world markets to assess fully the crop's potential.

References

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