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CHICORY

Family: *Compositae*

Genus: *Cichorium*

Species: *intybus*



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<http://www.primefocus-iowa.com/Chicory.html>

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General Background

Chicory is a familiar wild plant in many parts of Northern Europe, found particularly on calcareous soils. It has been traditionally cultivated in European agriculture as a grassland herb, as a root crop to produce a coffee substitute or as a vegetable, the young shoots being eaten (Gill & Vear, 1980).

This is a hardy biennial or short-lived perennial belonging to the sunflower family. It has a long stout tap-root which penetrates deep into the soil. During the first season a rosette of shiny oblong leaves is produced, these have a prominent midrib and may be rounded or pointed at the ends. The stiffly erect, tough grooved stem appears during the second summer. The mature chicory plant may grow to 150cm in cultivated types.

The flowers are large and azure blue, and occasionally, but rarely pink or white. Flowers are borne on upper parts of leaves on very short individual stalks. Flowers open successively upwards, though they will often close during dull weather.

Details of Quality Characteristics

Chicory is of interest to industry because the swollen taproot contains a high proportion of the storage carbohydrate inulin. At harvest, roots contain 75% inulin on a dry matter basis. Inulin is a polymer of fructose molecules with an end glucose molecule and can be used for the production of fructose syrups.

Fructose is approximately 1.3 times sweeter than beet sugar, so less calories are used for the equivalent sweet sensation. In addition fructose syrups may be used as feedstocks for fermentation processes and chemical transformations with a wide range of applications.

Current Production and Yields

The major production is in Belgium where over a hundred years ago 13,000 ha were grown under cultivation. This decreased to less than 100 ha in 1970, currently some 5,000 ha are cultivated annually in Belgium and the Netherlands, this area is expected to increase. Production is also reported in France, Germany, Hungary, Poland and South Africa. Yields

are generally comparable with beet, up to 50t/ha of fresh roots being produced, giving about 9t inulin/ha.

Production potential:

	Fresh Root t/ha	Dry root t/ha	
Belgium	48.0 - 61.8	16.3 - 19.5	(Baert <i>et al</i> , 1993)
Netherlands		12 – 16	(Meijer <i>et al</i> , 1993)
Germany	42.6 - 62.7	18.0 - 21.6	(Frese <i>et al</i> , 1991)
Austria	34.4 - 42.8	14.8 - 21.2	(Dersch <i>et al</i> , 1993)

Constraints upon Production

Chicory prefers a humid climate although wet summers are unfavourable. It is well adapted to the climate of western Europe.

Chicory is susceptible to soil-borne *Sclerotinia* and *Rhizoctonia* spp. so an adequate period between crops is essential. It is also a host of the nematode *Meloidogyne hapla* but it is not hampered by it. Chicory is not a host of the beet cyst nematode (*Heterodera schachtii*).

Markets and Market Potential

In many agricultural systems in Europe chicory is a more reliable producer of inulin than Jerusalem artichoke because crop yield is considerably less variable. Work to improve yields, root shape and disease resistance of the inulin producing varieties is ongoing in Belgium, Netherlands, France and Germany.

Derivatives of inulin may be useful for a wide variety of industrial applications for example in the production of detergents, solvents, polymers, pharmaceuticals and plant protection agents.

Chicory can be eaten in several forms; coffee, leaves, flowers and roots. Leaves and flowers can be added to salads but often have a rather bitter taste. Roots are cooked like parsnips and are eaten as a vegetable. Inulin is a starch that cannot be digested by humans, it tends to pass straight through the digestive system. Due to this inulin can be used to make a sweetener that is suitable for diabetics to use. The roasted root is used as a caffeine-free coffee adulterant or

substitute. Young roots have a slightly bitter caramel flavour when roasted, roots over 2 years old are much more bitter. There are three main types of chicory grown for their leaves, there are many cultivars of each form:

- A bitter tasting loose-leaved form is grown as a green winter vegetable, especially in southern Italy
- A narrow-leaved, witloof or Belgian form has a compact elongate head (chicon) which is blanched for use in salads or cooked dishes
- A broad-leaved (usually red) form produces cabbage-like hearts, these are generally less bitter than the other forms and are eaten raw or cooked. These forms are often used as a winter salad crop

Chicory can also be used as a herbal remedy, particularly for its tonic affect upon the liver and digestive tract. Both roots and leaves can be used although roots are more active medicinally. Root extracts have experimentally produced slower and weaker heart rate. The latex in the stems can also be applied to warts to destroy them.

The crop also has potential as a biomass crop for industrial use, they are rich in the starch 'inulin' which can easily be converted to alcohol.

A blue dye has also been obtained from the leaves.

Other Information

It is sometimes included in seed mixtures on shallow chalky soils in England, as pigs/cattle eat the leaves, and for the effect of the deep tap root breaking up the subsoil. Chicory can be a good plant for grazing producing forage with 18-22% protein and 62-77% dry matter content. Chicory should be grazed heavily, leaving a stubble height of 1.5-2 inches, for short periods of time. This intense grazing should prevent plants from bolting. A rest period of at least 25-30 days between grazing will allow chicory stand persistence and optimum performance.

It can be grown as a root crop, the roots being processed for the manufacture of a coffee substitute. For this Magdeburg chicory is used, drilled at about 5 kg/ha and yields about 25t/ha.

The crop requires deep, well-drained soils and although yields will be reduced, will tolerate a degree of drought. It is sown in April when the soil has warmed. Plant population should be 15 - 20 plants per m² in rows 45 - 50cm apart. Weed control is important during slow early growth. Some herbicides are available for use in chicory. It responds well to applications of N, P, and K. Up to 150 kg/ha nitrogen, 200kg/ha phosphate and 250kg/ha potash is recommended for good yields. For optimum production pH should be in the range of 4.5-8.3 (preferably 5.5-7.0). Roots are normally lifted during October and November using the same techniques as for sugar beet. Machinery may have to be adapted to suit chicory as roots are generally smaller and more fragile, conveyor speeds should be reduced and chain links narrowed.

In Europe, chicory is generally followed in the rotation by a cereal crop. At least a five year rotation is strongly recommended to avoid soil exhaustion and other problems. It is recommended chicory does not follow these crops in the rotation: sugar beet, where weed beet can multiply; maize, where herbicide residues are a potential problem; and potatoes and oilseed rape, where volunteers can be a problem.

Chicory is a good bee plant, flowers open in the morning and generally close around midday. Maximum life of chicory stands with good quality will be about five to seven years.

Research

Useful Websites

BioMat Net

[Chicory \(*Cichorium intybus*\)](#)

[FAIR-1896 - Production of Novel Fructans Through Genetic Engineering of Crops and Their Applications](#)

[AGRE-0007 - Production and Utilisation of D-Galacturonic Acid as a Basic Chemical Substrate](#)

[FAIR5-CT97-3585 Transformation of chicory into a high value non-food crop.](#)

[Crops for Biopolymers/Gums](#)

Contacts

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Clapham, A. R.; Tutin, T. G. & Moore, D. M.; (1987) *Flora of the British Isles*; 3rd Edition. Cambridge University Press

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Frese, L., Damrbroth, M. & Bramm, A. (1991) Breeding potential of root chicory. *Plant Breeding* (106) 107-113.

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