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BELGIAN ENDIVE (*Cichorium intybus*)

Belgian Endive, also known as witloof (or “white leaf”) is a long season root crop (like parsnips) that requires an additional vernalization and “forcing” stage (often in winter) to grow its tightly packed, light-colored heads called chicons. The roots are grown during the summer in the field, then transferred to a forcing environment where the chicons develop.

Thought to be first discovered by accident in the 1800’s by a distracted chicory-coffee root grower, these chicons are now a premium-quality greens crop most commonly grown in Western Europe and used primarily in soups and salads that serve a pleasantly sweet, nutty flavor with a refreshing crispness. Similar to lettuce, they are low in calorie content, but distinctively high in vitamins. While extra management is certainly required for growing Belgian endive, it can enable growers to offer a new crop for the winter produce market. Additionally, it can complement controlled environment production of vegetable, flower, mushroom, or even aquaponic operations. The roots do not have to be grown in the same place as the chicons, but instead can be sold from one grower to the next in the same way that mushrooms or tulips are often purchased for growing to the final finishing stage.

SITE SELECTION AND SOIL PREPARATION:

Belgian endive requires a well-drained soil in full sun. Soil with moderate fertility is recommended. The soil must be loose (heavy clay is not advisable) and deeply cultivated so that the roots are able to penetrate the soil to a depth of at least 12”. Mildly stony soil is acceptable because unlike most other root crops, forked roots are only inconvenient and do not necessarily affect the chicon quality.

High nitrogen sources should be avoided since excessive nitrogen causes too much leaf growth, low quality roots for forcing, unfurling during forcing, and higher risk of soft rot diseases. Too much potassium can have a similar effect, but adequate supply of phosphorus, potassium, and magnesium ensures the production of high-quality storage roots. Soil testing for adequate nutrient levels is recommended; levels of 50–100 pounds per acre of phosphorous and 150–200 pounds per acre of potassium are sufficient for optimum yields.

PLANTING:

Seeds from a reputable source are highly viable for 5 years with proper handling. Direct sow in mid- to late spring as Belgian endive requires a long season, 110-130 days. The ideal soil temperature for germination is 50°F/10°C. Planting too early can result in bolting, but plants can easily tolerate light frosts at the end of the season. If the roots are to be stored in a root cellar or other location dependent on ambient temperature, harvest should

be timed so the storage area will be sufficiently cold. In this case, count backward from the ideal harvest period to arrive at the planting date. For us in Zone 5, this is late June or early July.

Sow seeds $\frac{3}{4}$ –1” apart (about 18 seeds per linear foot), $\frac{1}{4}$ – $\frac{1}{2}$ ” deep, in single rows 16–24” apart for 3 rows planted on a wide bed. Planting in a band can help ensure a good stand.

Ensure that the soil does not dry out during germination. Unlike carrots and parsnips, Belgian endive seeds are quite vigorous and should germinate quickly. A few weeks after emergence and around first cultivation, thin the seedlings to 2–3 inches apart.

GROWING ON:

Water requirements later in the season are flexible, but very sandy soil may need more frequent irrigation. Keep weeds under control with shallow cultivation on a regular basis. Avoid excessive hilling which could cause crown rot during wet weather.

HARVEST OF ROOTS:

Optimum root shoulder diameter for harvest is 1¼–2¼", with a root length of 8". When looking at a cross-section of a root of this size, the growing point should be between ¼ and 3/8" tall. Reddening of the outer leaves can be another good sign of physiological maturity (time to harvest).

Roots too small in diameter will produce small or loose unmarketable heads, while roots that are too large (with a growing point over 3/8") are more prone to producing sideshoots, may not produce a larger chicon than slightly thinner roots, and will take up too much space in the forcing chamber.

Branched roots are usable as long as your planting system can accommodate the physical structure. You can also trim the branches to a central root as long as the remaining root matches the ideal dimensions (1¼–2¼" diameter shoulder, with a root length of 8").

Optimal dry matter levels of the root should exceed 22%, ideally 24–26%.

Small numbers of roots can be harvested with a digging fork. For larger mechanical harvests, use a root lifter or modified potato harvesting equipment. Be gentle and discard roots with visible damage (such as bruises, splits, or damage from voles) which may encourage rot during storage or excessive sideshooting of the chicons.

STORAGE OF HARVESTED ROOTS:

To prepare roots for storage, trim off the leaves, leaving at least 1" to avoid damaging the growing point of the future chicon (*Image 1*). Do not wash roots.

For adequate vernalization, store at 96–98% humidity and temperatures no higher than 32°F/0°C. Commercial growers strive for cooler temperatures, around 30°F/0°C. The longer the intended storage, the more critical it is to meet these specifications; slightly warmer temperatures may promote pre-sprouting or other less desirable qualities and less control over the forcing stage. Small numbers of roots can simply be stored in the refrigerator. For moderate amounts, a root cellar or walk-in cooler is ideal. A cool garage or barn can also be suitable.



Image 1. Roots ready for storage.

Place roots in a plastic bag (slightly ventilated or woven plastic is best). Or, for short storage of up to 1½ months, roots can be covered loosely with damp sacks or tarps to prevent them from drying out.

Monitor the roots regularly; sprinkle with water if roots are drying or increase ventilation if there is any slime or mold. Discard any roots with noticeable mold.

Forcing is possible after only a week's storage (even sooner if the roots were exposed to freezing temperatures pre-harvest) but for best success, store roots for 6–10 weeks.

FORCING IN CONTAINERS:

Site Selection & Conditions:

For optimum results, strive for complete darkness in the forcing area, maintain constant soil and air temperatures (Table 1), and provide some air circulation with a relative humidity of 90%.

With carefully controlled conditions, the chicons will be of a much higher quality. Signs of poor chicon development may be slower growth, slightly open heads, hairy stems, or greenish coloration. You will probably want to stagger starting times to ensure a continuous supply.

Basements, greenhouses, a closet, or specially built rooms in a barn or other building will be suitable forcing locations. A cool area where bottom

heat can be supplied will provide the ideal warmer-soil-than-air environment. Cover windows and doorways with black plastic to maintain humidity levels and exclude sunlight.

FORCING PERIOD	SOIL/WATER TEMP (°F/°C)	AIR TEMP (°F/°C)
SEPT–NOV	71–77/22–25	64–70/18–21
DEC–JAN	64–70/18–21	58–66/14–19
FEB–MAY	60–64/16–18	55–59/13–15

Table 1. Environmental Conditions for Forcing

Growing Media & Containers:

For forcing, you will plant the roots into growing media in containers. Any size container can be used but it should be light enough to maneuver once filled with growing media and it should be deep enough to accommodate the roots and prevent them from falling over.

Note: Chicons forced in growing media may require additional pruning to remove outer leaves that trapped media, whereas Ebb-And-Flow or water systems will generally produce a cleaner product.

Forcing for Home Gardeners:

Home gardeners not concerned with commercial quality appearance (tight, heavy heads) can force roots with ease. The only variable that negatively affects flavor is light exposure; as long as complete darkness is maintained, roots can be forced in a diversity of settings such as a basement or closet. Roots can be forced in just about any container as long as it is deep enough to fit the trimmed roots and comfortably contain the growing media, whether growing media or liquid nutrient solution. Home gardeners should follow the same general steps for root preparation, at right.



Image 2. Chicons in 5-gallon bucket

Root & Container Preparation:

1. Trim the bottom of the roots to ensure a uniform length of 6–8”.
2. Moisten the growing medium and fill the containers.
3. Simply insert roots upright into the growing medium. Roots may be placed as close to one another as needed; Optimal density is 25 roots/ft². Approximately ¾ of the root length needs to be in the medium—do not cover the crowns with media. The root crowns can extend above the sides of the containers but should all be roughly even in height. Roots can be planted after filling containers with a moist growing media, or the mix can be placed loosely between roots that have been stacked vertically in their containers.
4. Once the roots have been situated in the containers, moisten the growing media again to help the roots settle.
5. Place containers in some sort of leak-proof tray and located over heat mats (if needed to maintain soil temperature).
6. Placing additional pressure on the roots from above (with growing media and/or insulation and plywood) can help develop tighter chicons, especially in less-than-ideal conditions.

7. Black plastic draped over the whole forcing environment will increase the quality of blanched color and crisp texture of the chicons.
8. To maintain humidity level during forcing, moisten the growing media and add a fine mist in the grow room as needed. Check soil moisture regularly throughout the forcing period and keep it damp but not saturated.
9. Remember to adjust your heating system to compensate for changes in the outdoor temperature.
10. A dim light while watering or checking the crop will do no harm.

FORCING IN AN EBB-AND-FLOW SYSTEM:

Large-scale operations force Belgian endive roots in ebb-and-flow systems, where a nutrient solution floods the containers that the roots are in and drains out. In many of these systems, the trays are stacked, which saves space and may allow for solution recycling.

Using an ebb-and-flow system is most practical if building an entirely new structure or if a system is already in place for another crop—such as hydroponic lettuce or other forced flowers and roots. For the stacked tray method, warm water with an added nutrient solution is slowly pumped through the top trays; the drainage and pump speed are regulated to maintain about 2 inches of water in the trays. The water drains downward to the lowest layer where it is collected, aerated, reheated, and re-circulated. This may eventually increase the air temperature of the location the roots are being forced in, necessitating some cool air ventilation. Soluble fertilizer added to the nutrient solution, while not entirely needed, will increase the total weight of the chicons. The water temperature should begin low, 50°F/10°C, and may be raised through the first week to the specified temperature for that forcing period.

DISEASES AND PESTS:

With the recommended 4-year rotation in the field, Belgian endive is for the most part trouble free. Leaf miners are possible insect pests. Damage by leaf miners can be identified by “tunnels” that appear on the leaves. *Sclerotinia* (white mold) can be a problematic fungus. Powdery Mildew and

Cercospera can cause damage to the foliage and reduce root yields. Check with your local Cooperative Extension Service for control methods.

HARVEST OF CHICONS:

Chicons should be ready for harvest in 21–29 days, depending mostly on temperature. The heads should be firm and about 5 inches long. For optimum weight and quality, the core of a head cut lengthwise will be just under 40% of the length. This ideal core length decreases somewhat for chicons forced later in the winter.

Harvest by using one hand to grasp the root and with the other hand, gently snap the heads from the root. Trim off any loose leaves with a sharp knife. If not using them right away, strip off the shorter outer leaves as well since they will turn brown first in storage. Keep chicons clean and unwashed, as washing can cause the chicons to brown. Protect the heads from light, even after harvest, to keep them from greening and becoming bitter. Harvested chicons should store 2–3 weeks without loss in quality. In Europe, the heads are marketed covered with blue or green paper or plastic which helps exclude light and retain moisture.

If left in the growing media or water media, the roots from previous harvests can re-grow some secondary growth which is probably not marketable on a commercial scale but certainly usable for a home gardener. The second harvest will have a similar quality but lower volume to the 1st harvest.



Image 3. Harvested Chicons

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