
New York Agricultural Experiment Station.

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CULTURE AND FORCING OF WITLOOF CHICORY.

J. W. WELLINGTON,
UNDER THE DIRECTION OF
U. P. HEDRICK.



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SUMMARY.

Witloof chicory is a salad plant little grown in America but of wide and extended use throughout Europe. It is an improved variety of the common chicory, *Cichorium intybus* Linn., a native of Europe but now found naturalized in many parts of this country and often a pernicious weed.

The chicories are often confused with the endives, *Cichorium endivia* Linn. They are closely related species but are distinct, the first being perennial, the latter generally annual, though sometimes biennial.

The culture of Witloof chicory has attained great importance and perfection in Belgium and France, from whence large quantities were imported to America previous to the war.

In the belief that this vegetable can be grown and forced profitably by American gardeners, this Station is conducting investigations relative to its production.

It has been found that plants may be easily grown from seed in our environment.

Roots having a crown diameter within the limits of one to two inches produced the greater number of marketable heads.

Sand proved to be a very satisfactory medium with which to cover the forcing roots, in that it is easily obtainable, blanches the leaves perfectly and promotes the formation of compact heads.

Temperatures averaging 56° and 61° F. were found satisfactory in producing a marketable crop. It is evident that a range of 50° to 60° F. is approximately the optimum.

The harvest produced at the Station was acceptable in quality and appearance and is much superior to the foreign product in flavor and in freshness.

Culture of this chicory is so simple that it is evident that American gardeners are missing an opportunity in neglecting its cultivation.

INTRODUCTION.

Botanically, Witloof chicory belongs to the great Composite family and to the species *Cichorium intybus* Linn. In its wild state chicory is found along the roadsides and in the fields of Europe and has now become naturalized in this country and in many sections is a pernicious weed. Great confusion exists between this species and *Cichorium endivia* Linn., which embraces the common garden endives in their various forms. The two species are closely related but are distinct, the chicories being perennials while the endives are usually annuals, though sometimes biennials. The terms chicory and endive are frequently interchanged, our seed catalogs adding to the confusion by calling Witloof chicory, "French endive". This last name, though incorrect, is almost the only one known in the markets.

Many old writers contend that chicory and endive are of common origin while others ascribe the habitat of chicory to Europe and that of endive to East India, China and Japan, asserting that endive was first introduced to Europe about 1550 A. D. Pliny, Columella and other early Roman authors describe a plant, seemingly identical to endive, grown in their time in Roman gardens and used as a potherb and salad. Another ancient writer states that endive was held in very high esteem by the old Egyptians. It seems apparent that chicory and endive have been cultivated by man since time immemorial, and it is safe to state that the origin of each is lost in antiquity.

CHICORY AND ENDIVE AND THEIR CULTURE.

VARIETIES OF CHICORY.

There are several distinct varieties of chicory. Five kinds were grown upon the Station¹ grounds at one time, Common, Improved Very Large Leaved, Long Rooted Brunswick, Large Rooted Brussels or Witloof and Large Rooted Magdeburg. The last three are all used for forcing and, being similar, are probably all used in producing

¹ N. Y. Agr. Exp. Sta. An. Rpt., 1884 p. 286.

Witloof. The Common, or Wild, is also used to a limited extent for this same purpose.

Wild chicory, or succory, has had an extended use as an adulterant and substitute for coffee. The roots are used for this purpose, being dried, roasted, and ground. The product resembles true coffee in appearance and somewhat in taste. Chicory has been in use in America for many years as a field crop and in this manner the plant has been distributed about the country and in many regions has become naturalized as an escape from cultivation. Chicory may often be seen along the roadsides and in untilled fields and in midsummer is especially distinguished by its tall spike of attractive sky-blue² flowers. Wild chicory has been used as a medicinal plant although usually classed as an aliment. It is used as a potherb as are dandelions and the root forced in winter yields both heads and loose leaves, the latter known in the markets as Barbe de Capucin. The heads are, however, inferior in size and shape to those produced from the improved varieties.

Witloof chicory is an improved horticultural variety differing from the wild form in having a much larger root and big, broad, smooth leaves. Its place of origin is ascribed to Brussels, Belgium, and in consequence is often called Brussels chicory. The name Witloof is more exact, as there are other improved forms grown in the vicinity of the Belgian capital.

In view of the fact that modern practices in chicory culture are less than a century old, it is not surprising that so few distinct varieties exist and that much confusion should have arisen concerning the botanical classification of the plant. For many years the Belgians monopolized the culture of chicory but gradually the French learned that they could produce an equally good product and now Witloof chicory is grown extensively in the neighborhood of Paris and other French cities. In America little has been done with the plant in a horticultural way although some roots are raised and a small amount of salable chicory produced, but in no measure equal to the demand. In 1913 Witloof chicory was quoted in the London markets at 4 to 8 cents per pound showing that the vegetable can be profitably grown and sold at a comparatively low figure. Previous to the war Witloof sold readily in American markets at 25 to 30 cents per pound retail, the small shipments now occasionally received

² Sometimes pink and very rarely white

wholesale at 50 cents per pound. The difference now existing between sale price and cost of production is remarkable.

VARIETIES OF ENDIVE.

There are a great many varieties of endive, *Cichorium endivia*. Fifteen were growing at one time on the Station³ grounds. The present bulletin is not concerned directly with endive and mention is made of varieties only because one at least, Broad-leaved Batavian, is often used to produce a winter salad called Escarolle which is sometimes confused with chicory salads.

WINTER SALADS FROM CHICORY.

A very attractive salad is made from the blanched leaves of Witloof chicory. The leaves are, when offered for sale, in the shape of a compact head, and owe this appearance to the manner of forcing. Witloof may be produced from wild chicory or from the improved varieties of other name, but the best product is forced from the true Witloof variety.

Barbe de Capucin is made from the leafy portion forced from the roots of wild chicory and often from those of the improved varieties. It differs from Witloof in appearance only, being offered for sale in the shape of loose-leaved heads. This salad is obtained by forcing the roots in darkness but without cover of sand or loose dirt.

These salads have a flavor like that of mild dandelions, a trifle bitter but soon very pleasing to the taste. They may be served fresh like lettuces or cooked like other potherbs. The leaves are very tender and succulent and present a very delectable salad dish at a season of the year when fresh vegetables are almost unavailable.

FOREIGN METHODS OF CULTURE.

Witloof chicory production has attained great importance in the skilled hands of the Belgian and French gardeners. Therefore, it seems particularly advisable that a brief review of foreign methods of handling this crop should be given at this time. Free use has been made of Prof. Henri Chevalier's⁴ article on Witloof and of

³ N. Y. Agr. Exp. Sta. An. Rpt., 1884, p. 285.

⁴ *Gard. Chron.* 53: 405, 406. 1913.

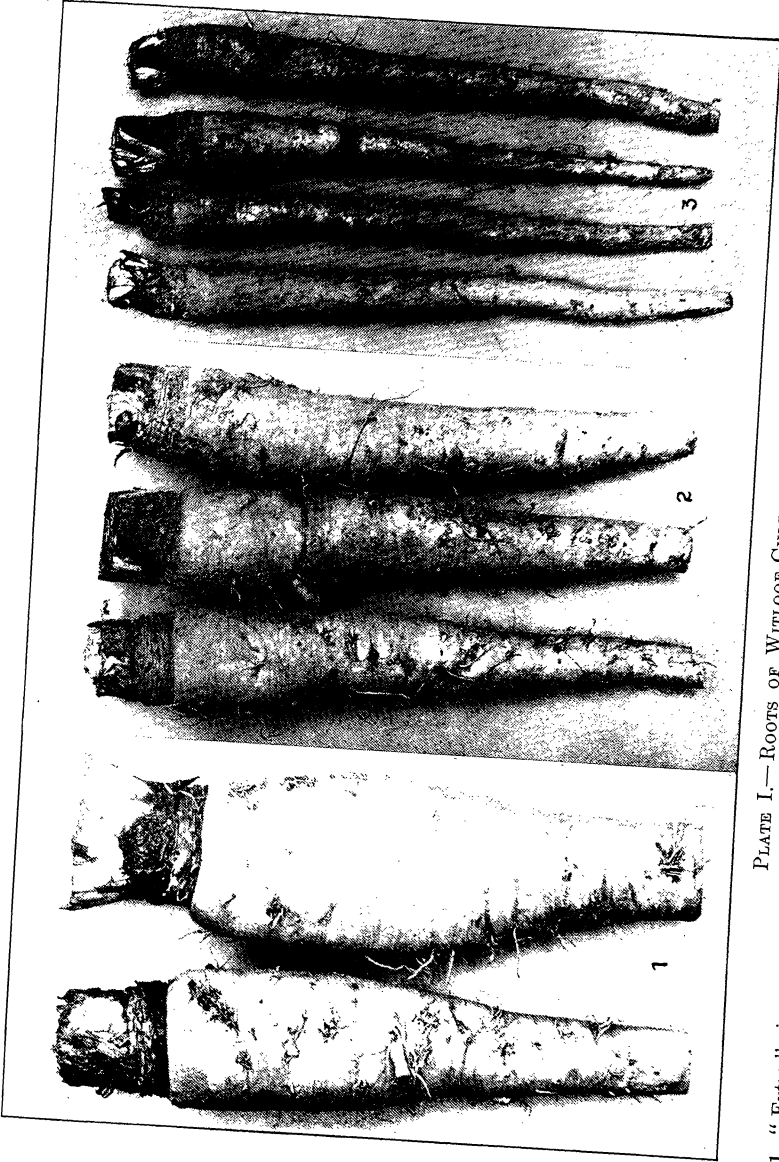


PLATE I.—ROOTS OF WITLOOF CHICORY FOR FORCING.
1, "Extra" size,—too large, producing compound heads (Plate II, fig. 2); 2, "Small" size, too small.
3, "Large" size,—very satisfactory;



PLATE II.— WITLOOF CHICORY HEADS.

1, Heads from roots shown in Plate I; left, too large; center, ideal; right, too small; 2, compound head; 3, forced roots, with crowns and heads.

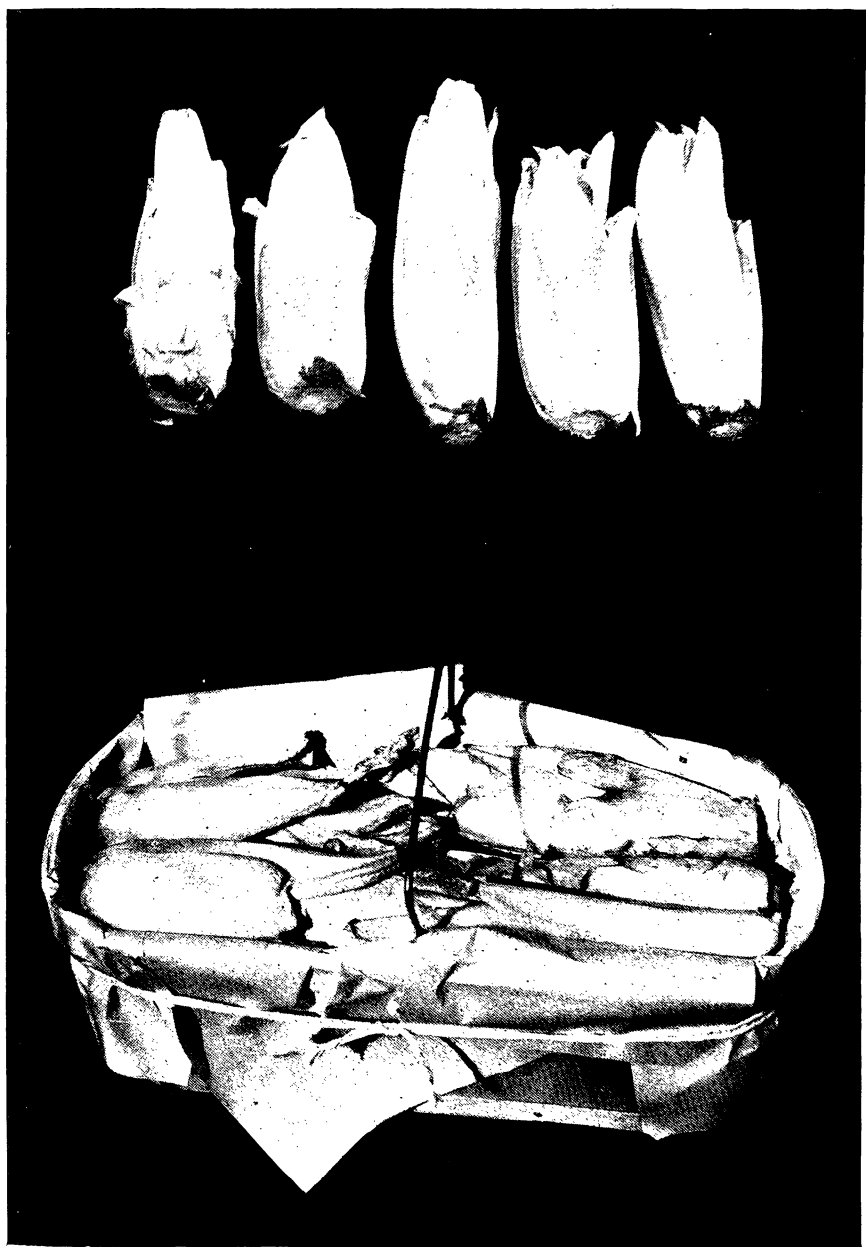


PLATE III.—WITLOOF CHICORY AS MARKETED.

Upper, desirable heads; lower, heads packed in 3 lb. Climax basket.

a Vilmorin-Andrieux et Cie.⁵ pamphlet on chicory growing. It is worth noting that there were, in 1913, 7,136 acres devoted to growing Witloof chicory in the vicinity of Brussels, not counting the extensive acreage about other Belgian cities. The exports for 1912 of Witloof from the port of Antwerp to America were 26,000 pounds and this did not represent anywhere near the total exportation to America, as consignments were also shipped from London and French ports. Belgium supplied Witloof to Germany, Switzerland and other European nations in large amounts.

Three varieties of chicory are in use by European gardeners: (1) wild, or common, (2) Witloof, and (3) Brunswick. The seed is sown in the open ground in late May or June — too early sowing may result in premature flowering. Especial stress is laid by European writers on the desirability of having seed of improved varieties, with the statement that other seed predestines poor results. The seed is sown in rows 10 inches apart and the seedlings are later thinned to 10 inches in the row. Frequent tillage is given and any plants showing a tendency to flower are removed. About the end of October the roots are lifted and those not desired for immediate use are stored in pits and covered with leaves. Those for immediate use are trimmed to a length of 8 or 9 inches and placed upright in specially prepared trenches. Belgian gardeners often prepare hot beds in warm, dry cellars or make use of a hot-water-heated, portable frame for outdoor work. This frame is known as a "thermosiphon" and with it a constant temperature of 60° to 70° F. is obtainable. This outdoor method is said to excel in the production of heads of uniform size and quality. In either manner of forcing, the roots are set upright in rows about six inches apart and two to three inches apart in the row. The roots are carefully placed so that all the crowns are on approximately the same level. After planting, the beds are covered with eight or nine inches of specially dry and loose soil.

The French system is the same as the Belgian outdoor method except that instead of using hot water pipes and frames for heat, a depth of twenty to twenty-four inches of fresh horse manure is laid over the completed bed. With this method twelve to twenty days are required to produce marketable heads, or "chicons" as they are called abroad.

⁵ Vilmorin-Andrieux et Cie., Paris. Circular.

When developed sufficiently — length four to six inches — the heads are cut from the roots, removing with the head a portion of the crown to keep the leaves together. The heads are cleansed of poor leaves, are washed and packed in basket hampers containing 10 kilograms (22 pounds).

STATION STUDIES ON WITLOOF CULTURE.

Interest in Witloof production at this Station has been of several years' duration and had its inception in the belief that this salad plant was well worthy of greater attention by American gardeners. It was evident that foreign methods of outdoor forcing would be of little value here in those months (December, January and February) during which this salad is in particular demand. Proper methods of forcing had to be established before a successful result could be anticipated. The cutting off of the foreign supply and consequent high prices has undoubtedly been the stimulus to carrying forward the work to an early conclusion. Preliminary trials in Witloof forcing proved one or two facts and showed also many points needing further study. It was found that a straw covering above the roots would not produce desirable heads while sand used for the same purpose yielded excellent results. It was seen that proper temperatures, suitable soils and covering materials, amount of water required during forcing, desirable size of roots and length of time necessary to produce a marketable crop were points all needing further investigation. In the preliminary work roots were purchased from a grower outside the State and it was thought advisable in the final work to grow roots on the Station grounds so that all phases of the culture might be under observation.

WORK OF 1915-1916.

Growing roots.— Seed of Witloof chicory was purchased in the early spring of 1915 from Sutton and Sons, Reading, England, it being desired to have as nearly as possible the same strain of seed as that grown abroad. The seed was sown about May 1st in the open ground in rows eighteen inches apart and later the plants were thinned to six inches in the row. Ordinary culture was given throughout the summer and since the plants made a peculiarly thrifty growth no special effort was devoted to their culture. They had the appearance of large, luxuriant, smooth-leaved dandelions. The roots

were lifted in November before freezing of the ground and the leaves trimmed away to within two inches of the crown. They were then packed in boxes and stored in a root cellar.

Forcing.—On January 3, 1916, the roots were brought from the cellar and graded into four lots, which for the purpose of distinction were termed Extra, Large, Medium, and Small. The number, average weight and size of roots in each lot, are shown in the following table:

TABLE I.—GRADATION OF ROOTS OF WITLOOF CHICORY USED IN FORCING.

SIZE.	Number used.	Average crown diameter.	Limits of crown diameter.	Average weight.*
		<i>Ins.</i>	<i>Ins.</i>	<i>Ozs.</i>
Extra.....	22	2	1.75-2.75	8.72
Large.....	34	1.39	1.19-1.75	4.83
Medium.....	52	.88	.75-1.10	2.00
Small.....	44	.64	.50-.75	1.07

* Trimmed and ready for forcing.

The plants have a very long main root and for convenience in handling it was necessary to trim the roots to a length of 8 or 9 inches. This shortening in no way interferes with the size or quality of the forced head as there is apparently a great excess of stored food. Some ungainly double and crooked roots were discarded on account of inadaptability to setting in the forcing soil.

In order to obtain two different temperatures during the forcing the roots were divided into two groups, each embracing roots of all the four lots. A large box was placed in each of two greenhouses ordinarily operated at quite different temperatures and one group was placed in each box. For sake of clearness the house having the higher temperature is designated as House 1, the house having the lower temperature as House 2 and boxes therein Box 1 and Box 2 respectively.

Unfortunately, as shown in Table II, the temperatures were not as widely separated as was anticipated. It will be seen that a variation of 5.2° in the mean temperatures of the two forcing soils was recorded. This was not sufficient to produce any marked difference in the respective harvests.

TABLE II.—TEMPERATURE OF SOIL AND AIR IN HOUSES WHEN FORCING WITLOOF CHICORY.

BOX 1 (HIGHER TEMPERATURE).			BOX 2 (LOWER TEMPERATURE).		
Date.	Soil.	Air.	Date.	Soil.	Air.
January, 1916.	<i>Deg. F.</i>	<i>Deg. F.</i>	January, 1916.	<i>Deg. F.</i>	<i>Deg. F.</i>
3.....	Start	3.....	Start
4.....	48	59	4.....	51	47
5.....	52	53	5.....	50	49
6.....	56	61	6.....	49	46
7.....	60	63	7.....	57	48
8.....	63	58	8.....	55	46
9.....	61	60	9.....	56	53
10.....	61	56	10.....	54	55
11.....	68	67	11.....	60	54
12.....	72	67	12.....	60	50
13.....	72	63	13.....	59	55
14.....	66	58	14.....	58	47
15.....	64	58	15.....	56	54
16.....	60	46	16.....	58	52
17.....	58	42	17.....	60	56
18.....	60	55	18.....	60	52
Average.....	61.4	57.7	Average.....	56.2	50.9

The setting of the roots was accomplished by one man holding the root and packing the soil while another slowly shovelled. The soil used was old greenhouse material. Fertility is of no importance, as the roots do not draw on the soil for food, and any material that will pack closely about the roots and hold them in position should prove satisfactory. The crowns were all on the same approximate level. After setting, the soil was thoroughly watered and on the following day a covering of 8 inches of sand was placed over the bed. Standard soil thermometers were used in obtaining the temperatures and readings were taken at 8 A. M. It was noticed that the soil temperatures varied but little from night to day and did not change as rapidly as the surrounding air. The boxes were watered at regular intervals. Since the edible portion is largely water it is necessary to keep the soil moist during forcing. In a cellar it is evident that one good watering in the beginning might produce good results. At the end of the fourteenth day it was noticed that some leaves were protruding through the sand, showing that the crop was ready to harvest.

The effect of the somewhat higher temperature in Box 1 was evidenced in the smaller proportion of solid heads and in the tendency to shoot up too rapidly. Although the average of this box was only 61.4° F., there were days when it was too warm for best results. It was evident that a steady temperature of about 60° F. would be the optimum and that lower degrees would be satisfactory but would require more time to mature a crop.

TABLE III.—EFFECT OF DIFFERENT TEMPERATURES IN FORCING WITLOOF CHICORY.

SIZE OF ROOTS.	Number of roots.	Total weight of heads.		Average weight of heads.	Variation from average of both lots.	Percentage of marketable heads.
		Lbs.	ozs.			
Box 1.—Average soil temperature 61.4° F.						
Extra.....	10	3	10	5.8	+ .62	50
Large.....	21	4	11	3.57	+ .17	67
Medium.....	18	1	14	1.66	+ .10	67
Small.....	18	1	1	.94	+ .01	33*
Box 2.—Average soil temperature 56.2° F.						
Extra.....	12	3	8	4.66	— .52	50
Large.....	33	6	13	3.30	— .10	76
Medium.....	34	3	3	1.50	— .06	76
Small.....	26	1	8	.92	— .01	46*

* Really too small to be correctly classed as marketable.

The size of head was in accordance with the size of root used. The Extra size produced many ungainly, compound heads consisting of many small divisions, edible but not attractive for market. There were many good shaped heads produced from the "Extra" roots but these however were generally too large for best market uses, being above the size desirable for individual portions in the restaurants and cafes. These large heads were often of stronger flavor than that of the smaller specimens. The Large and Medium lots produced many marketable heads and of a size suitable for market. The small roots yielded many small pencil-shaped heads which, though edible, would not pay for the trouble in handling. Table III shows the comparative weights of heads from the two

boxes. The head most desirable for market is from 4 to 6 inches long and weighs 2 to 3 ounces. In the Station test those roots whose crown diameter was within the limits of one to two inches produced the greatest proportion of satisfactory heads.

TABLE IV.—RELATION OF FORCED HEADS OF WITLOOF CHICORY TO ROOTS, IN WEIGHT AND QUALITY.

SIZE.	Number.	Total weight of heads.		Average weight of heads.	Percentage of marketable heads.
		Lbs.	Ozs.	Ozs.	Per ct.
Extra.....	22	7	2	5.18	50
Large.....	54	11	8	3.40	72
Medium.....	52	5	1	1.56	73
Small.....	44	2	9	.93	41

The length of time required for forcing the crop was 15 days, showing that a commercial crop can be grown in a comparatively short period and that several crops might be grown in the same soil during a winter season. Lower temperatures would undoubtedly lengthen the period required. Higher temperatures than those of Box 1 would probably result in a growth of long spindling leaves.

Sand proved a very satisfactory covering medium in that it is clean, is easily obtainable and promotes the formation of solid compact heads.

The space required per root is so small that a small area produces a valuable crop at present selling prices.

The Station crop of Witloof chicory was of the best quality, the heads being compact in shape and perfectly blanched. In the local market, which has in previous years handled imported Witloof extensively, the opinion was that this home grown product excelled the foreign grown in quality and freshness. The cultural requirements of Witloof are so simple that this crop well deserves much greater attention in the hands of home gardeners; and at present prices it cannot fail to give good financial returns to market gardeners.