Chicory Growing.

[Compiled from Bulletin No. 19, by Morris G. Kains, U. S. Department of Agriculture, Division of Botany.]

Although chicory is in many sections a troublesome weed, we hear most of it as an adulterant for coffee. Its tender roots, when boiled and served with butter, are considered a great delicacy by many Europeans, and the young green leaves when cooked in the same manner as spinach or dandelions, except that two waters are used, are much appreciated as greens. As a commercial crop, however, it is the dried ground root that commands the greatest attention. Its use in Holland as an adulterant of coffee was kept secret until the early years of the present century, when the adulteration became known to the public. Its use as a beverage upon the European continent is now as well established as that of tea, coffee or cocoa. Many substances, such as roasted cereals, acorns, sweet potatoes, etc., have been suggested and tried with varying success as coffee substitutes, but chicory still holds first place. We, on this side the Atlantic, are prejudiced against its use largely on the ground that it is a cheap substitute for what we believe to be coffee.

From the standpoint of health the case does not seem very clear against the moderate use of chicory. Experiments with chicory were tried by several persons who tested its qualities, both alone and mixed, in varying proportions with different grades of coffee, and none spoke favorably of the chicory when used alone. With the exception of only one case, it was found that a small quantity of chicory added to good coffee improved the flavor and reduced the peculiar nervous effects of the coffee.

Raising the Crop.—Chicory is generally grown in Europe, and seems to do well in a similar range to that of sugar beet. It produces well on all land, except the heaviest clay and lightest sand. The surface soil should be deep and the subsoil open to allow ample span for the extension of the long tap root. In the sandy loams, the roots, being slightly smaller, may stand closer together in the rows; in the clayey soil they should be farther apart. That the soil should be well drained is as necessary in this as in any other root crop. The autumn preparation of the land for the crop should resemble autumn cultivation preceding sugar beets, carrots, or mangels. In the spring, a gang plow or heavy cultivator should be used as early as the ground can be properly worked. A harrow should be used every ten days, and after each rain that is hard enough to form a crust, until the weather and the ground become sufficiently warm to insure good germination of the seed.

The ground being in a high state of tilth, sowing should be commenced as soon as the weather is favorable, or as soon as it would be considered wise to plant corn. Sowing may be done by means of a garden drill, from 1 to 1½ pounds of good tested seed per acre. After setting the drill it should be tested until it is found to drop 20 to 30 seeds to the foot. The seed may be planted one-third of an inch deep if the soil is in favorable condition, or deeper if the soil is dry. If the cultivation is to be done by hand the rows may be from a foot to 15 inches apart, but if a horse is employed 18 inches apart is narrow enough.

While there are many varieties of chicory, Brunswick, Magdeburg, and Schlesische are the best known kinds used in America for roasting. These grow from 10 to 14 inches long and from 2 to 2½ inches thick below the crown.

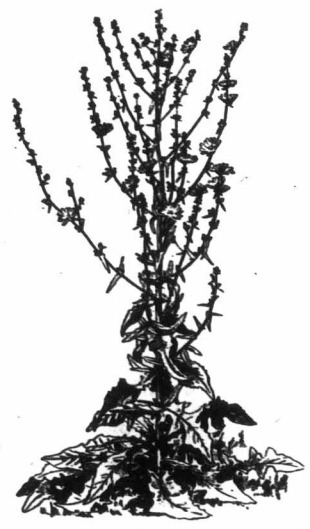
Two or three days after the seed has been sown the weeder should be run over the entire field in the direction of the rows. Hand labor in weeding is thus greatly reduced. Thinning should be done as soon as the leaves of the plantlets have spread an inch or not more than two inches. An interval of at least four inches should be left between the plants. This may be increased to about six inches if desired. After the thinning, and when the plants have obtained a good foothold, the regular cultivation should commence. At first the ground should be scratched to the depth of only an inch or so, but later, as the season advances, the depth may be increased to two or three inches, the object being to conserve moisture in the soil. The hand wheel hoe or cultivator should be run between the rows once in ten days or two weeks, and after rain, until the crop has obtained full possession of the ground. If horse power is preferred, one of the power cultivators or hoes may be used.

Harvesting and Storage.—Chicory, like other field roots, increases in weight more rapidly in September than during any previous month. The harvesting should upon this account not commence until October. Frost should be guarded against, since a root frozen is a root spoiled, at least if allowed to thaw out in the field. If it is sliced when still frozen, however, and put in the kiln to dry, but little damage is done. The plow is useful as a means of loosening the roots to be taken up, but where chicory is grown extensively the chicory-root loosener, similar to the sugar-beet loosener, answers a better purpose. When the roots are taken up the top is cut off at the crown, and the root is then ready for the factory. When it is impracticable to deliver the roots to the manufacturer at once, they should be thrown in piles 4 or 5 feet wide, 2 or 3 feet high, and 7 or 8 feet long, and covered with clean straw and earth, leaving holes at the top for ventilation. They may be safely pitted in this way, if protected from the frost, with small loss for six months.

Yield and Profit.—While from six to ten tons is the common range of production per acre, with good culture in a favorable season as much as 15 tons may be raised, and it has been found by one grower that five tons per acre will usually in his case pay all the expenses incident to growing the crop. While it is reasonably safe to count in ordinarily favorable circumstances upon a net profit of from $15 to $30 per acre, if proper attention is given and the distance from factory is not too great, it must not be forgotten that chicory is a special crop, and that it cannot be raised with the certainty that there will be a demand for it such as there always is for staple crops, such as corn, wheat, and potatoes. In 1897 American manufacturers contracted for the product of some 2,000 acres more than previously, and one manufacturer who in 1897 paid $6.50 per ton announced that he would pay $7.50 per ton in 1898.

Process of Manufacture.—For the sake of cleanliness the roots should receive washing by emptying them into a long, narrow vat or tub which is kept half full of water, and in which there rotates a worm screw constructed of diagonally placed paddles. When the roots are clean they are then thrown out by a set of parallel prongs arranged like rake teeth. The roots now pass into the cutting machinery, in which the knives are set parallel in a cylinder which revolves. The roots after being cut are elevated by chain or strap buckets to the kiln floor. The kiln is built of brick and iron, and, preferably, has an iron roof, since there is often great danger of fire. The furnaces are placed upon the ground floor, upon either side of a passage extending from one side of the kiln to the other. They are built so that the whole of the heat is carried up through the mass of drying root upon the kiln floor, which is usually about eight feet above the fire grates, and built of steel or sheet iron, with numerous perforations large enough to insure a good draft, but too small to allow the particles of dry roots (cossettes) to pass through. They are frequently turned by hand shovels specially constructed for the purpose. The temperature

Chicory roots and leaves: *(a)* schlesische variety, root with leaves; *(b)* Brunswick and Magdeburgh varieties, root. (Both 1-12th natural size.)



Chicory plant in bloom for seed. (1-20th natural size.)

of the freshly filled kiln is usually not less than 100° Fahr., and this is generally increased towards the completion of the process. When sufficiently dried they are cooled and stored. In the process of drying the root loses a great part of its weight, as much as from three to five tons of green roots being required to make one ton of dried product. In some seasons the roots are more watery than in others.

The dried root is now ready for the roasters. The roasting is done in large coffee roasters. About a pound of butter, lard, cocoa butter, cottolene, or an equivalent volume of mustard seed, sunflower seed or rape-seed oil is added to the above quantity of cossettes, partly to keep them from burning, partly to make them less hygroscopic, and to give them a "coffee gloss," but primarily to carry the color in, and thus give the product an even tint when ground. After an hour's roasting the cossettes are emptied into a perforated tray, attached to which is an air-tight box, whence a tube leads to a suction air shaft. A current of air is thus drawn through the smoking mass, which cools the material in a few minutes. When cooled it is ready for grinding. The grinding or breaking is done with iron rollers, and to separate the grades the ground mass is bolted and put in packages or sold in bulk. In mixing chicory with coffee, about one part of the former to four of the latter is a fair proportion in which to mix the two, although some tastes prefer either more or less of the chicory.

Finger-and-Toe in Turnips.

The disease known as finger-and-toe, which frequently attacks the turnip crop in Great Britain, and is not unknown in Canada, having in some instances proved exceedingly troublesome, has received special attention by Mr. J. R. Campbell for the Lancashire County Council. At one station, on a badly infested field, 10 cwt. of crude potash per acre did no good; nor did a mixture of manures containing superphosphate, dissolved bones, bone-flour, bone meal, kainit, and sulphate of ammonia. Twenty-four loads of lime compost, applied in December, gave a vastly improved result, while the same dressing, put on in the spring, did comparatively little good; and, strangely enough, twenty-four loads of sea sand, applied in December, was as beneficial as the lime compost used at the same time, though it contained only about 4½ per cent. of lime. Four tons of quicklime, used in December, was much less effective than the lime compost or sand, which, again, is remarkable. At the other station the land was inoculated with diseased roots, excepting one plot on which a fair crop was grown. That the land was badly infested was clear, and this shows the importance of keeping diseased roots out of the manure heap. Where 8 cwt. of superphosphate was used the crop was completely destroyed; and the application of the same quantity of basic slag gave a result hardly any better. Three tons of lime compost, applied in December, did a considerable amount of good, while the same dressing, put on in the spring, was much less beneficial; but the quantity was far too small, and much better results were obtained from the use of three tons of quicklime, the early application again proving much more effective than the late one.

DAIRY.

How Milk Absorbs Impurities.

The statement made by Professor Russel, of the Wisconsin Experiment Station, that he had put warm milk in the vicinity of several substances having strong odors, and that at blood heat it absorbed any odors more rapidly than did cold milk, is of itself a sufficient reason for removing the milk from the stable as soon as the milking is completed for each cow, and putting it where it will be in pure air, or taking it at once to the dairy room.

But it also shows quite as strongly the need of having pure air free from bad odors in the stables while the milking is being done. The stream, as it passes from the teat, exposes much of its surface to the air, and it is ready, even in that short passage from teat to pail, to pick up all the odors, bacterial germs, and dust with which it comes in contact.

While it would be inconvenient to follow the suggestion of one writer, who would have every cow removed from the stalls where they have been kept during the night, into a clean room where they should be milked, we can approach very near that condition by cleaning the stables, and using an absorbent like gypsum or land plaster on the floor behind them, if we have pure air entering to take the place of that which is foul.

But the necessity for pure air in the stables is by no means limited to the hour of milking; if we want milk pure and free from odors, and if we followed the plan of allowing the cows to remain in a filthy stable, filled not only with the odor of their fresh excrements, but with that from a decomposing heap below them, and removing them to pure air when we were ready to milk them, we should find bad odors and disagreeable flavors in the milk.

The air they breathe goes to the lungs, there to act upon the blood, which in its turn is distributed through the system, and has its effect upon the lacteal organs, and foul air in the lungs will affect the milk as surely as would onions taken into the stomach and passed through the digestive organs. See that the stables are ventilated at night, and cleaned well before beginning milking, and the bad odors will not be very troublesome.

Discourages Preservatives.

A very interesting discussion has been carried on in the London *Dairy* regarding the use of preservative in butter. In one issue a correspondent concludes with this absurd statement: "Always use preservative in curing your butter—it prevents injurious, disease-producing microbes from attacking it, and makes it wholesome and easily digested." Replying to this, Prof. C. W. Sorenson, formerly chief dairy expert to the New Zealand Government, says: "Whether from a standpoint of good business, commercial morality, or public health, a more misleading statement could not well be made. In the first place, preservatives are not essential to the curing of good butter, especially Irish butter, which is produced almost on the spot where it is consumed. Not a pound of Danish butter contains preservative, and no one will accuse Danish butter of not keeping well. I myself have exported hundreds of tons of butter from New Zealand to the London market, made in my own and other factories, without an ounce of preservative of any kind except common salt, and have received no complaints as to keeping qualities. In fact, two-thirds of the butter sent from New Zealand to-day is, to the writer's certain knowledge, free from preservatives, and the market price affords the most convincing proof that butter can be successfully sent from the Antipodes without preservative. Yet we are told that English and Irish butter, made to-day and eaten to-morrow, must be 'preserved' with the aid of doubtful drugs! Then, as to preservatives 'preventing the attacks of injurious, disease-producing microbes,' any one with the most elementary knowledge of bacteriology must be aware that boric acid, which is the basis of most preservatives, has no such property, even if used in much greater proportions than is possible in buttermaking. The same may be said of any and every other ingredient that may be employed without markedly affecting the taste of the article treated. And finally, as to preservatives rendering food 'wholesome and easily digested,' I think that in the face of all the medical evidence to the contrary, the bald assertion on the part of the writer of the article in question can scarcely be accepted as the most satisfactory form of proof."