



HOP GROWING

The growing of hops (*Humulus lupulus*) in Eastern Canada has been carried on as a specialized culture for many years. Canada has always been on an import basis for hops. Canadian imports of hops amounted to 1,454,948 lb. in 1937, 1,087,490 lb. in 1938 and 782,232 lb. in 1939. Over 60 per cent of these imports were from Great Britain and Continental Europe, the remainder from the United States of America. War-time exigency will probably cut off the source of supply from other countries, especially those European nations which formerly shipped large quantities to this market.

In Canada hop production has fluctuated widely since 1900. In that year British Columbia production was estimated at 299,717 lb. and Ontario production as 603,075 lb. Ontario production dropped off sharply after 1900 to a low of 1,189 lb. in 1920, while British Columbia production increased to 1,013,400 lb. in 1910, with a slight drop in 1920 to 755,545 lb. Increased interest in hops since 1930 has been general both in Ontario and British Columbia. In Ontario approximately 200 acres were grown in 1939 with an estimated total production of 160,000 lb. while in British Columbia 1,205 acres of hops were grown in this same year with a total production of 1,830,000 lb. and a gross value of \$586,000.

Soil Type and Climate.—In general, hops do well on a fairly wide range of soil types. It is essential that the land be well drained and quite fertile. In Eastern Canada the greater part of the area planted to hops is sandy loam soil of medium to good fertility. This soil type is usually better drained than the heavier soils and is, therefore, much more suitable for hop production.

Regional Adaptation.—Hops usually can be grown in those areas where the soil type is suitable and where the growing season is such that harvesting is possible during the latter part of August and early September. Under moderate climatic conditions such as are found in the hop districts of British Columbia this crop can be grown on somewhat heavier soils but in Eastern Canada it is imperative that it be grown on well drained sandy loam to avoid the heavy losses occasioned by heaving due to frost and subsequent winter killing of the roots. Even when grown on light soils some winter killing does occur in hops but, with adequate snow cover, which normally is the case in Eastern Canada, the damage is usually slight.

Fertilizers.—Farmyard manure at rates varying from 12 to 20 tons per acre has been the usual fertilizer application. This manure is applied in the fall on top of the hills to serve as a protection against winter-killing and in the spring is spread as fertilizer.

In 1937 experimental work dealing with applications of chemical fertilizer supplementing farmyard manure was undertaken by the Experimental Farms Service on the Illustration Station located at Fournier, Ontario. Nitrogen was applied in three forms, as nitrate of soda, ammonium sulphate and tankage. Phosphate and potash were also applied singly, in combination with one another and with nitrogen. The complete fertilizer application corresponded to 750 pounds of 4-8-10 fertilizer per acre. Finely crushed agricultural limestone was applied on a series of plots at the rate of one ton per acre alone and in combination with chemical fertilizer. A basic application of 20 tons of manure was made on all plots including the check.

Wherever nitrogen was applied a decided increase in yield was recorded. Phosphate alone did not give marked increases. Potash alone apparently encouraged the formation of coarse open cones while nitrogen gave a smaller cone with less stem and a greater amount of hop yolk or lupulin. In general, the best results have followed an application of 750 pounds of 4-8-10 fertilizer supplementing 20 tons of manure per acre. This manure and fertilizer treatment gave a four-year average yield of 1,315 pounds of dried hops per acre in comparison to the manured but unfertilized land which recorded 946 pounds per acre.

Planting and Cultivating.—Hops must be grown on clean soil. Before setting out a hop yard the land should receive after-harvest cultivation the year before to ensure the destruction of weeds. This procedure will guard against many difficulties which arise in weedy land and will reduce the cost of maintaining a clean yard.

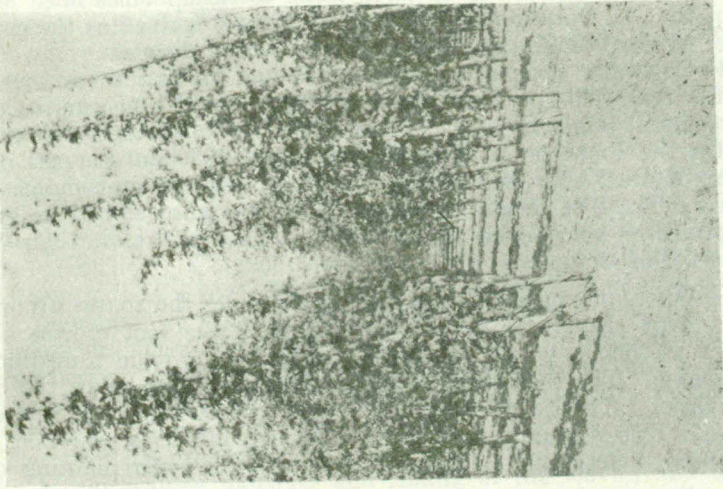
Hops are herbaceous perennials and are not propagated commercially from seed. Cuttings of the underground stems, which consist of sections of the underground runners with roots, are selected, each bearing two pairs of buds or growing points. Two cuttings are planted perpendicularly in the ground one foot apart at each of the hills which are spaced at 9 feet in the row with 8 feet between the rows. Before planting, the field should be cross-checked and a small stake put in to mark the proposed location of each hill.

Planting in Eastern Canada is usually done in the spring. Since hops produce no cones the first year the practice normally followed is to plant a nurse crop of potatoes or beans between the hills thus allowing for intertillage and at the same time avoiding loss of crop.

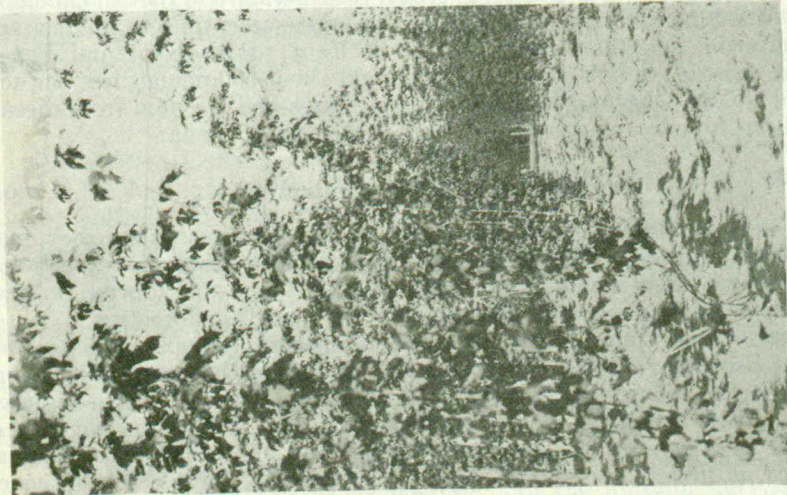
Hops are dioecious, that is the male or the pollen bearing flowers and the female which are the cone bearing flowers, are found on separate plants. When setting out a hop yard about one male hill to each 70 or 100 females is usually sufficient to ensure adequate fertilization of the flowers or cones. Seedless hops may be produced by the elimination of male plants from the hop field, thus preventing pollination of the female flowers and subsequent seed formation. While seedless hops are usually of better quality, the yield is lower and to date no premium has been offered for this type of hops on the Eastern Canadian market.

Thorough cultivation at medium to shallow depth is important and should begin early and continue until the plants are well armed out. If weeds are under control and no crust is forming on the soil very late cultivation may injure the feeder roots, induce early ripening and reduce yields. The disk harrow and the spring tooth harrow are effective machines for this work. Some growers cross plough the yard in the fall throwing the earth on to the hills and in the spring level the soil with an inthrow disk harrow. This procedure loosens up the soil and facilitates root stalk pruning operations.

Training.—The common method of training practised in Eastern Canada is to use poles. Two cedar poles 20 feet long and about 6 inches at the butts are planted in the row on each side of the hill. The poles are sharpened to a six-sided point at the base with more of a rounded, rather than a flat side



View of a Pole-Trained Yard. Note Placement of Poles in the Row and Clean Cultivation.



Interior View of a Trellised Yard—Fournier Illustration Station—1939.

to the point. Holes are punched using a steel hop bit or pick and the poles are placed in these holes. Three bines or vines are trained on each pole. Training usually begins when the vines have made from 2½ to 3 feet of growth. The six strongest vines are selected for training and two or three are left attached to each hill for replacements. A soft twine or raffia is used to tie up the vines. The yard should be gone over two or three times to tie up vines until all are following the poles. In Ontario the first crop of vines is trained as the growing season is not of as great length as in other hop-producing districts.

In British Columbia hops are trained on twine leading to an overhead trellis work of wires. This practice is not widely adopted in Eastern Canada as yet but substantial increases in yields have been recorded where this method is followed. On the Fournier Illustration Station in 1939 an increase of 296 pounds per acre of dried hops was recorded on the trellis area in comparison to the pole-trained field. The length of life of a trellised yard should be greater than a yard trained on poles owing to the fact that the roots retain their vigour for a longer period of time.

Pruning.—When all vines are following up the poles the spares are cut off and discarded. Any suckers or second growths from the root crowns should also be removed as they not only weaken the plant but provide a medium for infection by disease. The root stalk or crown is pruned just below the depth of normal cultivation. That is, all runners and side roots are removed to a depth of 3 to 3½ inches. This is usually done using a heavy hop hoe or grub hoe. The healthiest of these underground stems are used as sets when planting out a new yard.

When the hops have reached the tops of the poles the leaves for about four feet from the surface of the ground are stripped off. This allows for circulation of air through the yard, lessens the possibility of disease infection and is a partial control for red spider infestation. Vines should not be stripped too high or a "top crop" results and yields are markedly reduced.

Varieties.—The variety of hops most commonly cultivated in Eastern Canada is the Fuggle. Golden Cluster is grown rather widely in British Columbia and while it is a high yielding variety, it is the most susceptible to mildew and is a later-maturing hop than either Fuggle or Kent. Both Kent and Fuggle are somewhat resistant to mildew but usually yield about 600 pounds less per acre than does the Golden Cluster. Because of its earliness and freedom from disease Fuggle has been found to succeed very well in Eastern Canada.

Diseases and Their Control

The diseases to which hops are subject are not numerous, but they may cause considerable injury. Therefore, they are of decided economic importance. The chief diseases with which growers have to contend are downy mildew, powdery mildew, virus diseases, sooty mould, crown gall, and rootrot.

Downy mildew is probably the most serious disease of hops. It is caused by the fungus *Pseudoperonospora Humuli*. It may attack the young shoots that emerge early in the spring, or the terminal and lateral shoots. These diseased shoots fail to climb and have short thickened stems and curled, brittle leaves. The leaves are paler green than those on healthy shoots, and usually bear angular spots that are at first water-soaked, and later brownish. Parts of the cones may also be discoloured.

Stripping and suckering as outlined in the directions for pruning, together with dusting or spraying, are effective means of control. If infected shoots are removed immediately they are observed, and burned, it will prevent the disease spreading to other shoots, and will also stimulate secondary growth and the production of a good stand of vines. As soon as the vines are strung, or trained to follow the poles, it is advisable to either dust with copper-lime dust or spray

with Bordeaux mixture 4-4-40, depending on the machinery available. Spraying machinery is usually more costly than dusting equipment. There are many good commercial dusts on the market. These should contain at least one part of monohydrated copper sulphate to ten parts of finely divided hydrated lime. Dusting should be done in the evening or early morning when the dew is on the plants. About four applications of either dust or spray are required to obtain satisfactory control of the disease.

Powdery mildew is caused by the fungus *Sphaerotheca Humuli*. It is recognized by the white powdery growth on the leaves and stems. It prevents normal formation of the cones, reducing yields in proportion to the severity of the disease. Burning of mildewed vines in the fall or early spring before growth begins, and dusting with finely divided sulphur as soon as the disease appears, gives satisfactory control. Moisture is essential for the spread of the disease. Therefore, it is necessary to dust more frequently during wet weather.

Sooty mould is caused by a fungus growing on the honey-dew excreted by aphids (plant lice). Control measures are those which will keep aphids in check.

Crown gall is a bacterial disease caused by *Phytophthora tumefaciens*. It can be prevented by planting only healthy cuttings in soil free from the crown gall organism. Therefore, land that has previously been planted to fruit trees and raspberries, which are highly susceptible to crown gall, should be avoided when setting out a hop yard. Rootrot can be avoided by exercising care during cultivation in order not to cause mechanical injury to the roots.

The virus diseases affecting hops are mosaic, infectious chlorosis, and nettle head. Mosaic causes mottling and rolling of the leaves, and dwarfing of the plants. Infectious chlorosis causes a yellowing of the foliage, particularly during the middle of the growing season, and a reduction in yield. Nettle head causes a shortening of the stems and bunching of the leaves, and, therefore, a stunting of the plants. Plants affected by mosaic or by nettle head produce no crop, or only a few distorted cones. The three virus diseases are probably all transmitted by insects. The only means of control is to rogue out all affected plants as early in the season as possible, before insects have appeared and have had a chance to transmit the disease. In severe cases it is advisable to rogue out the adjacent healthy plants also, as in all probability they have already become infected.

Control of Insects Affecting Hops

In Eastern Canada, the only insect which seriously affects the growing of hops is the hop vine borer. The moths of this species lay their eggs in August, almost entirely on green foxtail grass growing as a weed in the hop yards or along the headlands. Control requires the destruction of this grass in the yards by cultivation some time before harvest, thus forcing the moths when they emerge to lay their eggs on the grass on the headlands where they can be destroyed by burning in autumn or early spring.

In British Columbia there are three pests of major importance attacking hops: the common red spider, the hop aphid and the hop flea beetle. These pests occur also in Eastern Canada but in average years do not cause serious losses.

Common Red Spider.—Remove from the yard and burn all vines and debris as soon after picking as possible. In the autumn bury all leaves and debris in the yards by ploughing. If the red spiders are found in the poles, spray them with diesel or stove oil. In the spring cut off and remove the first shoots, and destroy all weed growth by cultivation. If the red spiders are numerous at this time dust the ground with a 50-50 sulphur-hydrated lime dust about mid-April. The leaves should be stripped from the base of the vines and the leaves removed from the yard, to destroy the red spiders before they spread to the upper parts. This is usually done in May. If they appear on the vines in

summer, dust the vines with the 50-50 sulphur-lime dust. Where the infestation is light 25 to 50 pounds of this dust per acre will be sufficient but where heavy infestations occur this amount should be increased to 200 pounds per acre.

Hop Aphid.—This insect can be controlled either by sprays or dusts. The most effective spray consists of nicotine sulphate (40%), 1 to 800, with one pound of whale oil or fish soil soap added for every 100 gallons. Apply with a powerful automatic sprayer equipped with a fan-shaped rack of 10 to 12 fixed nozzles on the rear of the machine. Very effective control may be secured by applications of a 1 to 2 per cent nicotine-hydrated lime dust, applied when the air is perfectly still. Use from 50 to 100 pounds of dust per acre, depending on the growth of the plants.

Hop Flea Beetle.—These insects hibernate under leaves in nettle beds and brush piles. To control the pest, destroy the refuse by ploughing down or burning between October and February. Dust the hills with a 1 per cent derris dust in the spring, before the young shoots are tall enough to train, and apply a sticky adhesive to vines, posts and strings after the vines have been trained, stripping all leaves below the band.

Harvesting the Crop

Hops are usually picked about the middle of August when the cones are showing signs of firmness or in seeded hops when a darkening of the seed is observed. Another good indication is when the terminal bracts at the tip of the cone close, the hops can then be said to be mature enough for picking. When harvesting pole-trained hops the vines are cut about four feet from the surface of the ground. The pole is then pulled out and laid across the box into which the picked cones are put. After picking, all vines are stripped off the poles and placed in piles until dry and then burned. After picking and fall clean-up is finished the poles are planted two at each hill in preparation for the following spring.



Picking a Pole-Trained Yard.

Trellised hops are unhooked from the overhead wires, the cones picked off and the vines left attached to the roots until completely dry after which they are cut off and burned.

In picking hops great care must be taken to avoid including leaves and long stems as these tend to lessen the market value of the dried product. Picking is usually done by hand labour at a fixed rate for a certain quantity of hops. Mechanical pickers are in use in the United States but as yet have not been introduced into Canada.

Drying.—Hops must lose about 80 per cent of their moisture before they can be baled. A hop kiln consists of a two-storey building with a slatted ceiling covered with strong cotton separating the first and second storey rooms. Openings in the wall at ground level in the lower room and a roof ventilator, which can be closed or opened when necessary, in the upper room, provide for free circulation of air. The lower room, which has an earth floor, is the furnace room, while the upper room is the drying room. Large wood-burning stoves or oil-drum stoves are used. The overhead pipes should be at least six feet below the drying floor and lead to a chimney at the end of the furnace room. The green hops are piled on the cotton-covered slatted floor of the drying room to a depth of about 20 inches. Fires and ventilator are manipulated to keep the temperature below 140° F. until the heat breaks through the hops. This guards against the possibility of scorching the bottom layer of hops lying against the kiln-cloth. There is no definite length of time required to dry hops. Normally from 10 to 15 hours is required to dry and cool a kiln. Hops are sufficiently dried when the thin leaf-like portions break easily and the stems are shrivelled but still reasonably soft and pliable.

Sulphuring during the drying procedure has been practised generally in Eastern Canada. It is thought that the burning of stick sulphur or brimstone in pans on top of the stoves in the furnace room at the rate of from 1 to 4 pounds for each 100 pounds of undried hops is essential. This procedure tends to produce a golden-coloured hop as well as retarding chemical deterioration of certain desirable constituents, and thus improves their keeping qualities. Since the trade generally seems to favour a greener coloured hop the lower rate of sulphur is preferable. Some growers outside of Canada have discontinued using sulphur altogether thus producing a green type of dried hops for the market.

Curing.—After drying, hops should be cured for a period of ten days to two weeks before baling. This is to equalize the moisture content, make them more pliable and less subject to breakage, acquire a finer aroma and contribute to a better appearance. A hop curing barn should be of tight construction to prevent the loose hops from absorbing too much moisture from the outside air.

Baling and Storing.—After curing, hops are baled in heavy jute sacking. Hand balers are in general use in Eastern Canada but in other hop-producing centres mechanical balers are used. A bale should weigh between 185 and 210 pounds. Hops should not be trampled too much while baling as this breaks the cones resulting in a loss of lupulin or hop yolk and gives a poor appearance to the baled product. Bales should be well sewn with hemp twine to prevent breakage in transit.

Hops should be stored at an even temperature. When kept for long periods at high temperatures the desirable bitter soft resins and the essential oil contained in the lupulin are easily oxidized to hard resins which have no brewing value.

Marketing.—In other countries, notably the United States, hops are usually handled through wholesale houses but in Canada the crop is ordinarily marketed direct to the brewer. New growers should become acquainted with the local

market in their particular area and notify the prospective purchaser early in the season. This will allow for field inspection while the hops are still on the vines. After drying most purchasers require that a sample of dried hops be submitted for inspection in order to determine the suitability of the finished product.

Capital Expenditure

The first-year cost of establishing a hop yard in Eastern Canada varies from about \$90 to \$100 per acre. Capital investment in a bearing yard where all the necessary equipment must be purchased would be in the neighbourhood of \$250 to \$300 per acre. This figure does not consider the purchase price of land but does include the necessary equipment capable of handling a yard 10 acres in area.

Financing is one of the greatest difficulties that the hop grower will encounter. The revenue derived from sales of the dried product is received when the crop is sold in the fall of the year. Labour costs and material costs must be met by a reserve fund during the growing season and, coupled with complete dependence on the market situation, this presents a major problem to hop growers. When hops are grown as an adjunct to a regular farm organization the risk involved is considerably less as current revenue from the other enterprises aids somewhat in defraying the seasonal costs peculiar to hop culture.

The Labour Problem.—Hops require the use of large amounts of man labour. A prospective grower should consider the availability of this labour before going into production of this crop. During the season, apart from picking, over 400 hours of man labour is required per acre of hops. For picking one acre of hops approximately 1,200 hours of man labour is required. Because hops are picked during a period of approximately two weeks the need for an ample supply of available labour is apparent. The demand for horse labour is not great, approximately 54 hours of horse labour per acre per year being required for cultural operations and hauling.

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