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A. G. B. Bouquet
Horticulturist (Vegetable Crops)

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Sweet corn occupies an important place in the list of vegetables grown for the open market and for manufacture. No information is available regarding the acreage of sweet corn grown for marketing to cities or for shipment. As a matter of fact, this crop does not appear in the statistics of the United States Department of Agriculture in so far as car shipments are concerned. Most of the sweet corn grown in the United States other than that grown for canning and freezing is produced largely for local markets. The acreage of sweet corn has been comparatively stable for a number of years past, and production has not increased rapidly in the last decade as it has in the case of some other crops. There has been a slight increase in acreage, however, in the growing of corn for freezing purposes.

The annual mean acreage in the United States of sweet corn for manufacture for the ten year period, 1927 to 1936, was 305,440 acres. In 1938 the acreage was 341,460 acres. U.S.D.A. reports indicate that for the period from 1927 to 1936 the average annual acreage of sweet corn for manufacture in Oregon was 1,020 acres. Four thousand acres were reported in 1937 and 2,250 acres in 1938. In Oregon the crop is grown largely for local marketing, for canning and freezing, and for carlot shipping. The estimated number of cases of sweet corn canned in Oregon in 1929 was 6,250, but in 1937 this had increased to 117,594 cases.

It was estimated that the sweet corn frozen pack in Oregon and Washington in 1934 was 500,000 pounds. This was increased to 2,749,091 pounds in 1938, or nearly one-half the entire national pack of that year.

In comparison with the national canned corn pack of 14,250,000 cases, the western pack is of comparatively minor importance, representing slightly less than four per cent of that figure.

In recent years an industry of shipping green corn from Oregon to markets outside of the state has been developed, chiefly in Marion county. In 1938, 51 carloads were shipped out of Oregon, of which 48 were shipped mostly in September, with a few in August and October respectively.

The Plant and Its Relation to Climate

Sweet corn bears both the male and the female flowers on the same plant. The terminal portion of the main stem, the tassel, bears the male flowers, and on the ends of lateral branches near the center of the main stem are the ears bearing the well-known silk or female organs. Leaf sheaths overlap and form the so-called husks which enclose the ear.

The sweet corn plant is naturally a warm weather plant during practically its entire growth. The young plants of the first early plantings may be injured by late spring frosts. The growth of the plant, particularly in its early stages, is retarded by cool, wet weather but thrives in sunshiny, warm weather. During the period of ear production, however, high temperatures are not so desirable,

largely because during hotter weather the kernels pass more rapidly from the early milk to the dough stage, with corresponding change of desirable sugar into undesirable starch.

There is a popular belief that sweet corn grown and canned near the northern limits of its production is sweeter and of better quality than that canned further south. It has been shown, however, that the actual content of sugar in sweet corn differs comparatively little between that grown in the north and the south, but the rapidity with which the sugar is lost after harvest is in direct proportion to the temperature prevailing. Because of the lower temperatures which prevail in the northern areas during harvest time, the rate of kernel maturity is slower, This obviously results in a product which retains its tender quality for a longer period.

Soils

Earliness is one of the essential factors in selling sweet corn in a city market if a substantial profit is to be made. For early production a warm sandy loam soil is valuable, especially if it is high in humus, but the lighter sandy loam soils must be irrigated in order to produce sweet corn of high yields and good quality. If irrigation is not available, the soil should be more moisture retentive than the sandy loam. Moisture retention is aided by addition of humus. The yield and quality of sweet corn will be largely dependent upon the degree of soil moisture available during the dry period of the summer. If there is no incentive to plant sweet corn for earliness and the soil cannot be irrigated, a fairly heavy type of soil should be used which will be more retentive of moisture.

Corn will not grow nor yield well on impoverished land or that which is low in moisture content during the summer. The crop is sometimes planted in a rotation, including alfalfa or clover and some cultivated crops such as potatoes. Sod land is often undesirable because of the possible presence of wireworms.

Fertilizers

Sweet corn is a comparatively light feeder and when harvested for canning does not exhaust the fertility of the soil as do some other farm crops. The amount of plant food removed by cobs and kernels of a three ton yield per acre is said to be 45 pounds of nitrogen, 19 pounds of phosphoric acid, and 36 pounds of potash.

If available, an application of rotted manure is useful in providing organic matter, and it can be supplemented, if necessary, by an application of some commercial fertilizer. It is evident from the experience of various growers that good yields of sweet corn may be obtained by turning under a green cover crop such as vetch, etc., supplemented by the application of some commercial fertilizer.

In areas where good results have been obtained from the use of commercial fertilizers, the ratio of nitrogen to phosphoric acid to potash has been about 1-4-1. Commercial fertilizer having an analysis of 4-16-4 has been used and from 200 to 700 pounds of such material has been applied per acre, depending upon the manner of application of the material. It is generally agreed that superphosphate is important in stimulating early rooting and early maturity of the plants. Some quickly acting nitrogen such as nitrate of soda, calcium nitrate or sulphate of ammonia applied as a top dressing at the rate of 100 pounds per acre is also useful

in stimulating the plants during their early growth. Ammoniated phosphate to which some sulphate of potash has been added would also be a suitable fertilizer.

While there may be some difference in the ratio of these plant foods to each other, there will also be variations in the manner in which sweet corn fertilizer is applied. Formerly, practically all of the fertilizer was broadcast, but in recent years applications have been economically and profitably made by placing the material in a band to one side of the row. There is no evidence that fertilizer applied to the plants in this manner restricts root growth. On the contrary, a fertilizer band two or two and a half inches away from the rows has proved to be a direct stimulant to the plants. There have been definite indications that fertilizer applied in a band near the rows stimulated an early growth of the corn which tasseled and produced ears earlier than that which was fertilized by broadcasting.

In view of the fact that the gross returns in growing sweet corn for canning or freezing are comparatively small, it is necessary to economize on the amount and cost of fertilizer used and therefore the placement of a less amount in a band near the row will be more economical than broadcasting.

Because of their vigorous growth and large foliage, hybrid sweet corn varieties demand soil of good fertility. They will not produce well on land that might otherwise well support some of the open-pollinated varieties having less vigorous growth. This point is often overlooked.

Varieties

Varieties of sweet corn differ in such characters as season of maturity, size and shape of ear, color, size and shape of kernels, number of ears per plant and edible quality. The most popular varieties of sweet corn are those having golden yellow kernels, for white-kerneled varieties which formerly constituted the earliest sweet corn have been largely displaced in recent years by yellow varieties varying in season from early to late.

The most outstanding progress in improving sweet corn as a vegetable has been made during the last ten years or so in the breeding of hybrid sweet corn varieties and strains, several of which have largely displaced the previously-grown open-pollinated varieties. The seed of a single cross hybrid such as Golden Cross Bantam is produced by the transfer of pollen from one inbred strain to the silks of another and unrelated inbred. These two inbred lines are obtained by means of self-pollination of each of the inbreds for several generations. An open-pollinated variety such as Golden Bantam is one in which the seed is produced by natural cross-fertilization in the field in which any of the plants in the field may act as male or female parents.

The value of hybrid varieties may be indicated by the fact that during 1938, 80 per cent of the yellow sweet corn grown was from hybrid seed, 70 per cent of which was Golden Cross Bantam, which after a period of ten years still remains the most popular and widely grown yellow hybrid sweet corn. Such a hybrid variety as this has established itself because of unusual uniformity in ear characters, size and vigor of plants, evenness of maturity and high productivity in number of ears and tonnage per acre.

Due to the fact that the first hybrids were later in season than many open-pollinated varieties, there has been a tendency in the last few years for seed growers to develop earlier types of hybrid corn, few, if any, of which have attained the good characters and quality of Golden Cross Bantam. Varieties for the market garden and home garden such as Cockcrow, Golden Early Market, Gemcross, etc., may have unusual earliness but lack the quality and productiveness of the main season varieties.

One of the best quality, highest-yielding, early yellow hybrids is Seneca Golden. Tendergold has proved to be of good quality and slightly earlier than Golden Cross Bantam. Purgold is a little later in season than Golden Cross and has rated well in color and quality. Indigold has also rated high in color and quality for a late variety.

Seed and Planting

It is important to grow a crop of sweet corn from seed obtained from ears carefully selected for type and production. The new hybrid varieties demonstrate the value of combining desirable and congenial male and female inbred lines. The first generation from the hybrid produces corn that is exceedingly uniform in type, vigor and high production.

Some interesting results have been obtained in the grading of sweet corn seed before planting. In a lot of corn from the seed of large size, the per cent of plants in full tassel numbered twice as many as those from the ungraded seed and five times as many as those in the lot grown from the small seed. When all of the stalks grown from the large sized seeds were in full silk, only 25 per cent of the stalks from the ungraded seed were in full silk and only 10 per cent of the stalks from the small seed. Plants from the large kernels reached tasseling, full silk and a state of maturity well ahead of those from the small kernels.

The best hybrid sweet corn varieties mature more uniformly than do the open-pollinated sorts. This is an advantage in that a given lot of corn can be harvested in one picking or, at the most, two pickings. This will result in generally improved quality of corn because of the uniformity of maturity throughout the field.

There are two general ways of planting sweet corn, the hill and drill methods. The corn-seed hill planter is somewhat undesirable in that when planting the seed in the hill, the seeds are necessarily crowded and grow in a comparatively small space, both in regard to soil moisture and fertilizer. However, planting in checks makes possible cultivation in both directions, and when this method is used, it is probably undesirable to have more than two or three plants in a hill. The number, however, will depend on the soil type, its retention of moisture, the possibility for irrigation, and the variety to be grown.

In the drill method the seed is sown so that the plants stand approximately 12 to 16 inches apart in the row. The plants are better distributed than in the hill system and can draw on a wider area of moisture in the dry season. By this method, of course, cultivation is possible only in one direction.

Less productive soils will not be able to maintain as many plants per acre as richer soils, or those that have higher moisture-holding capacity. More plants can be grown on irrigated than unirrigated lands, moisture being the important factor in the crowding of plants. Usually six pounds of seed are used per acre.

The number of seeds in a pound varies according to the variety. For example, in the variety Earligold, there are about 1,700 seeds to the pound, whereas with Golden Cross Bantam the number will vary from 2,100 to 2,200 under western seed growing conditions.

In case it is desired to treat the seed before planting, this can be done by using one-half an ounce of Semesan to 15 pounds of seed. It is particularly desirable to treat the seed in case the season is late, cold or wet or it is necessary to plant the seed in soil that is unusually moist. The seed treatment material will protect the seed during germination and will ordinarily effect a more uniform stand of plants.

The seed must be dropped deep enough for proper moisture, the average depth of planting being about two inches. Some growers drop it in a shallow furrow, throwing the soil to the roots later on, but it has been demonstrated that the secondary root system establishes itself about the same depth whether the seed is planted moderately deep or shallow. If the corn seed is planted too deep, however, the young seedling may be exhausted before the leaves can start vigorous growth above ground.

It is unwise to plant corn seed until danger of frosts is about over and the ground has begun to warm up. For continuous production of ears, it is necessary that a number of successive plantings be made. If this is not done, successional harvestings can be provided by planting varieties maturing at varying dates. This is particularly necessary in the case of the market garden, the farm home garden and oftentimes where corn is grown for canning and freezing.

Cultivation

The primary object of cultivating between rows of corn is to destroy weeds. On soils that may crust or run together, cultivation may also be of benefit in keeping the texture of the soil intact, but light soils quickly form their own mulch and it is improbable that frequent cultivations will assist in conserving soil moisture. Corn cultivation should never be deep. The tools used should be those necessary for weed cutting and for the formation of a light mulch. There is no necessity for cultivating corn if there are no weeds, no rain, and the soil already has a satisfactory mulch.

Suckering

Observations of yields of sweet corn ears from suckered and unsuckered plants in field trials at Corvallis indicate a slight gain in total yield, yield per plant, and mean weight of ear from the unsuckered treatments, although there were few if any of the treatments where the increase was significant. No advantages appeared in total yield from the removal of suckers. There were definite indications, however, that suckering tended to increase the percentage of the ears harvested during the first two pickings. Many of the newer hybrid sweet corn varieties sucker quite freely and it may be desirable on a small scale in the home garden to remove them.

Irrigation

If sweet corn land can be irrigated, the advantages derived from watering are sufficiently numerous to warrant the application of water provided it can be done economically. The ears will usually mature somewhat earlier and possess much better grade and quality. Provided adequate space is available there should be fewer unproductive plants and fewer nubbins or poor ears.

Methods of irrigation include both the gravity or furrow method and the overhead system. The largest area of sweet corn in western Oregon grown for manufacturing purposes consists of some 200 acres which are irrigated with overhead rotary sprinklers. One grower estimated the increase in tonnage per acre at 1-1/2 tons, or an increase of $675 for 30 acres.

One grower reported an increase of 100 per cent marketable ears due to irrigation, with a net profit of over three and one-half times the cost of irrigation labor, electricity and charges of interest and depreciation.

Harvesting

Sweet corn rapidly approaches a suitable maturity for harvesting following the appearance of the silks. Especially is this true in warm weather, since there is a correlation between the temperatures prevailing and the rapidity of growth of the plant in reaching a state of harvesting. Such is shown in Table I.

Table I. Per Cent Sugar Content in Golden Bantam Sweet Corn

Age of silk in days	Dates of Plantings 1st 4/28	2nd 5/5	3rd 5/10	4th 5/23	5th 5/31	6th 6/7	7th 6/17	8th 6/27	9th 7/18	Remarks
5	4.57	5.22	5.38	5.44	5.21	4.96	3.96	3.80	3.91	
10	5.56	5.72	5.84	6.20	5.28	5.44	4.93	4.40	4.17	/content
15	6.84	6.58	6.92	6.44	7.36	6.28	6.16	6.64	5.21	Highest sugar
20	4.88	4.64	4.49	4.56	5.48	4.98	4.96	5.85	6.60	Prime condition
25	3.14	3.88	3.38	3.64	3.64	3.64	4.36	4.72	5.14	Too far advanced
30	2.06		2.96	2.74	2.36	2.96	3.54	2.90	3.82	
Date of Harvesting	8/5	8/10	8/10	8/12	8/19	8/23	8/31	9/13	10/2	
No. days to Harvest	99	97	92	81	80	77	75	78	85	

Temperatures prevailing during formation of kernels and ear development affect the rapidity of such development as indicated as follows:

Average* Daily Mean Temperature	Days Required to Pass From Pre-Milk to Best Canning State	No. of Days Canning Period
60	14.5	5
65	12	4
70	10	3
75	8	3
80	7	2
85	5.5	1.5

* After Hartley

It is desirable to harvest corn when at its best quality. Quality is closely associated with tenderness and the sugar content of the kernels. During the ripening process the sugar rapidly changes into starch, the kernels passing successively through the pre-milk, milk, early dough and dough stages. The difference between the characteristics of corn in these various stages is shown in Table II. It may reach its highest point of sweetness 15 days after silking

Table II. Variation in Sugar and Starch of Sweet Corn According to Development in Maturity of the Ear

Condition of Development of Ear	% Moisture	% Total Sugar	% Starch	Ratio Sugar to Starch
Pre-milk	85.10	6.26	3.29	1.903
Milk	80.16	5.79	7.72	.750
Early Dough	71.07	3.91	16.35	.239
Dough	64.00	3.17	21.62	.146

Best canning stage is between milk and early dough

but it is too immature and has an undesirable lack of body and flavor. If harvested too soon, also, the yield in tons of ear corn per acre and the cases of canned corn per ton will be low as compared with the corn which is picked at the stage between the milk and the early dough stage.

When ready for canning, sweet corn has passed the highest point of sweetness but is in a fine condition in so far as texture and body is concerned. When in the best canning state, the sugar content is from 5 to 6 per cent and the starch 10 to 11 per cent or a ratio of sugar to starch of .500. (See Table II).

In view of the relation of temperature to the rapidity with which the corn passes through the various stages of development, it is interesting to note in the accompanying table the time required to pass from the pre-milk to the best canning stage on the various temperatures. Also, the number of days in which the corn remains in the proper condition to be harvested is in direct correlation to the temperatures prevailing; that is, the higher the temperature during harvesting time the shorter the period during which the corn is in a suitable condition to be harvested. Bearing in mind the rapid rate at which sweet corn passes through the proper stage for canning, one can readily understand why uniformity of maturity is important. It is in this respect that graded seed of proven sweet corn hybrids is effective in producing a profitable field of corn.

Another important fact in regard to harvesting is the loss of sugar of the sweet corn after picking. In this loss, temperature plays an important part, for the higher the temperatures under which corn is kept until processed the more starchy it will become and the greater the loss of sugars. During the first 24 hours after harvesting, the loss of sugar at 86° F. is twice that at 68° F. Likewise, if the corn can be kept at a temperature approximating 50° F., the loss will be considerably less than that at 68° F. It is desirable, therefore, to reduce the temperature of the corn or process it just as rapidly as possible after harvesting.

Determining Maturity

There are several ways of determining when sweet corn should be harvested. First, the ear will appear plump and well filled at the tip; second, the silks will have turned dark; and third, a "feel" of the ear will indicate the kernel development and designate whether or not it is ready to pick. It is undesirable to pull down the husks to examine the ear to determine maturity for market.

The tendency of some sweet corn growers is to pick ears too mature rather than too young. Quality should not be sacrificed for fullness of ear or weight. No fine canning or freezing process can make a good pack out of an inferior or overmature raw product. This fact makes it imperative that the stage of development of the ear be very closely watched. In the market garden and home garden, it is possible by going over the plantings frequently to harvest the ears in their prime stage, but in growing ears for canning or freezing, harvesting may be done but once or twice. Uniform maturing of each planting is, therefore, of prime importance in production for canning or freezing.

Yields, Packages and Values

The number of ears harvested per acre may vary from 10,000 up to as high as 25,000 per acre. Probably an average would be about 15,000 to 18,000. A prominent grower of Golden Bantam corn, who produces quite a large acreage of corn yearly, annually figures on about 15,000 to 16,000 ears. Many of the better strains of hybrid sweet corn, however, produce up to 22,000 ears per acre. There is considerable evidence that strains of the same variety may vary considerably in producing power, and this is even true at the present time among the various strains of Golden Cross Bantam as well as other hybrids.

In tons per acre, sweet corn varies from 2 to 6 tons. Some growers have produced more than the latter figure, but this is unusual. The average yield for the United States in the growing of sweet corn for canning, over a 10 year period from 1927 to 1936, is 1.95 tons per acre, but the yield per acre for all producing sections was 2.57 tons in 1938.

Corn varieties vary in weight of unhusked ear from 7 to 12 ounces. Those in the upper brackets run from about 10 to 12 ounces, those in the middle from 8-1/2 to 10, and in the lower brackets are those from 7 to 8-1/2.

The five to seven dozen crate is the standard container.

Sweet corn for canning and freezing is estimated to be worth about $15 per ton. Early market corn brings 35¢ per dozen but the price drops rapidly under heavy receipts.

In the production of fresh corn for shipping to markets such as the California markets, the yield per acre is less than that obtained for cannery corn due to the more rigid culling of ears and the earlier maturity when picked.

A conservative estimate on the cost of producing an acre of corn is approximately $50.00, including costs of seedbed preparation, soil fertilization, cultivation, irrigation, land rental and harvesting. Freight, icing packages and handling charges involved in shipping corn total approximately $415.00.

Insect Pests

The corn-ear worm is probably the most serious pest with which the grower of sweet corn has to contend. The worms hatch from eggs deposited by a night-flying moth, which is capable of laying many hundreds of eggs. These eggs are laid on the upper or lower leaf surface, on the silks, husks, tassels, and even on the stalks. Quite a large per cent of eggs are laid on the silks.

Control of this insect is considered difficult. Calcium arsenate dust or fluosilicate dust can be used according to suggestions made in Extension Bulletin 523 on "Vegetable Garden Insect Pest Control." The first application is given when the silk is about two inches long, then repeated every three or four days until the silks are about dried.

Some of the newer varieties of hybrid sweet corn have long, tightly wrapped, thick husks which make them less susceptible to ear worm injury. The young worms themselves are cannibalistic, or have a tendency to destroy each other when young, otherwise there might be a larger number of worms in the ear.

Clipping off the tips of the ears, after the silks appear and pollination has taken place, has been tried with fairly encouraging results.

Wire worms are oftentimes destructive in sweet corn fields. Corn should not be planted directly on sod land, where worms are apt to be present.

In the last year or so the twelve-spotted cucumber beetle has done considerable damage to sweet corn by eating the silks, in some cases when the latter were quite young and before pollination had taken place. Where the sweet corn was dusted for control of the ear worm, very little injury was done by the twelve-spotted beetle, but in undusted sweet corn fields where beetles were very numerous the damage in some cases was such as to almost ruin the entire planting. Pyrethrum dust will kill the beetles.

(This is a revision of Extension Circular 270).
