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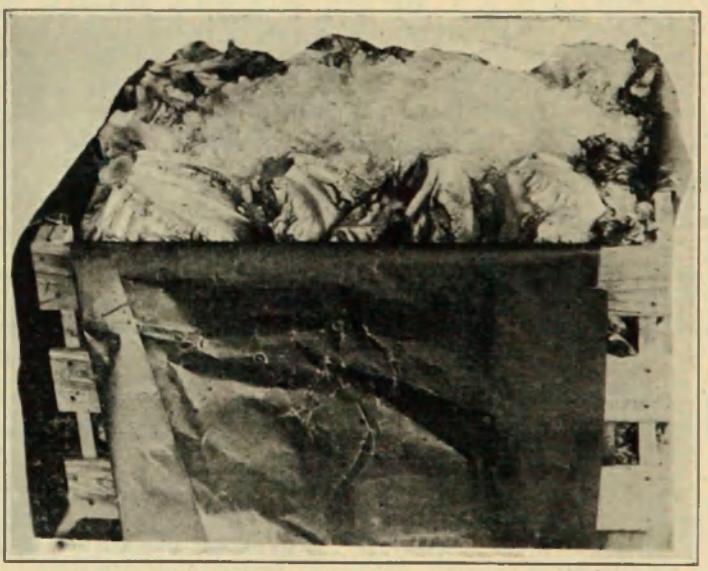
AGRICULTURAL DIVISION

HEAD LETTUCE IN COLORADO

By R. A. McGINTY



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HEAD LETTUCE IN COLORADO

By R. A. McGINTY

Five years ago head lettuce as a commercial crop was practically unknown in Colorado. Here and there a gardener would occasionally grow a small patch for market and a few amateurs grew it for home use. In 1918, Mr. G. D. Isabel of Canon City, an experienced truck grower, leased ten acres of land near Buena Vista and planted it to head lettuce. The crop was a wonderful success, yielding, it is said, a return of $7,000. The following year a larger acreage was planted and another good crop harvested.

Exaggerated stories of the large profits made in growing the crop were spread broadcast and almost every high-altitude section in the State began to "get into the game." The poor clerk, out of a job, the coal miner, off on a strike, and the capitalist with his thousands to invest, all became interested in a crop promising such great returns. Not only from Colorado, but from many other states came numerous inquiries for information as to the possibilities offered. In 1922, something like 6000 acres were planted to lettuce in the State, and in spite of the rather disastrous results of the season, indications point toward a still larger acreage in the future.

The concensus of opinion is that head lettuce has come to stay and that it will be one of the State's most important vegetable crops; in fact it already outranks, as far as acreage is concerned, all vegetables except potatoes and dry beans. While some growers have become discouraged and say they will not plant again, others consider it a good crop even under adverse conditions and expect to stick to it.

As indicated above, a great many people have been attracted to the lettuce sections by visions of prosperity and many of these have had very little agricultural experience, much less experience with crops as exacting as head lettuce. The need of this class of growers for information, together with a general lack of knowledge regarding the culture of the crop under the new conditions has made it seem desirable to publish this bulletin giving all the available information on the subject.

THE OUTLOOK FOR LETTUCE GROWING

The questions are often asked: Will the growing of head lettuce be overdone in Colorado? Will it be possible with the increased production to market the output successfully? Time alone can answer these questions. The land adapted to lettuce

growing is limited as regards climatic conditions, accessibility or facilities for irrigation; and expansion cannot continue indefinitely. The quality of the Colorado product is not excelled by that from any other section, which insures a good demand. The injunction to "eat vegetables for vitamines" is obeyed with greater alacrity than ever before, thanks to doctors and dieticians, and good head lettuce is an easy medicine to take. Of course there will be years when poor distribution or possibly over-production of a poor grade of lettuce will result in comparatively low prices, but growers on the whole seem to be

Lettuce field of S. J. Burleson, Buena Vista, July 4, 1922. The first head lettuce of any consequence in Colorado was grown on Mr. Burleson's land.

optimistic. Some state that they consider lettuce the best crop they can grow, even in the face of the poor returns of last year. However, one of the largest shippers of lettuce in 1922 expects, in view of the probable increased acreage, that the grower will receive less money for the 1923 crop.

While a gradual increase in the acreage of head lettuce in Colorado is to be expected and encouraged, it would probably be better for all concerned if the acreage for the time being could be somewhat reduced. There is no question but that growers have undertaken to handle too large areas in the majority of cases. The crop is one that demands special attention and no one should plant more than can be properly and promptly cared for at all stages of growth. This applies especially to those who are inexperienced in handling garden crops such as lettuce. Quality rather than quantity should be the aim.

One factor which promises to be of much importance in the

development of the lettuce-growing districts is the introduction of other crops such as peas, cauliflower, cabbage, and possibly celery. It has already been demonstrated that peas and cauliflower can be grown successfully in the mountain districts. When properly handled they may be as valuable as lettuce itself and the diversification made possible by their use will be a great advantage.

Marketing problems, lack of knowledge as to cultural requirements, diseases, etc., provide uncertainties which, many times, are not fully appreciated. These problems, however, do not seem to be beyond solution and in time will doubtless be worked out. This, together with the proper organization and cooperation of growers who should strive toward the production of quality lettuce and other vegetables will eventually establish the industry upon a stable and profitable basis. As a writer from the Imperial Valley, in California, puts it, "lettuce growing will have to be considered a regular line of farming and not a speculation. A rancher will not figure what years he can 'make a killing,' nor which crop of lettuce will 'make a killing' for him; he will have a definite amount of lettuce every year, produced evenly during the lettuce season. He will expect to sell some of that lettuce for little or nothing, perhaps, but he will feel certain that for a good part of that season prices will be high enough to make a comfortable profit for him."

Heads of mountain lettuce are as crisp and firm as cabbage—Experimental Plots, Colorado Agricultural Experiment Station, Buena Vista.

EXPERIMENTS WITH HEAD LETTUCE

The numerous appeals for information as to the details of lettuce culture led the Horticultural Department of the Agricultural Experiment Station to begin some experimental work at Buena Vista in 1922. The objects of the experiments are to determine the best cultural practices, to develop, if possible, a better strain of lettuce for Colorado conditions, and to investigate methods for avoiding losses due to diseases and "shooting to seed." The work will be continued until light has been thrown upon these problems.

The author of this bulletin will be glad to answer questions or receive suggestions regarding any phase of lettuce growing. The industry is new and it is only by the exchange of ideas and experiences that it can be put on a permanent and stable basis in the shortest time. Communications should be addressed to the Horticultural Department, Colorado Agricultural College, Fort Collins, Colorado.

CARLOT SHIPMENTS OF HEAD LETTUCE FROM POINTS IN COLORADO, 1922

Station	Altitude	June	July	August	Sept.	Oct.	Total
Alamosa	7546		1	6	—	—	7
Antonito	7888		—	1	—	—	1
Aspen	7900		—	1	3	1	5
Avon	7455		10	37	22	4	73
Buena Vista	7958		10	60	71	12	153
Blanca	7562		—	—	2	1	3
Carbondale	6142		—	8	3	—	11
Canon City	5344	1	—	—	1	6	8
Cotopaxi	6385		—	1	4	3	8
Creede	8840		—	40	23	—	63
Del Norte	7876		—	15	7	—	22
Denver	5280	4	3	3	—	—	10
Divide	9198		—	7	25		32
Eagle	6598		3	10	13	—	26
Florence	5199		—	10	59	16	85
Glenwood Springs	5793		—	2	5	1	8
Granby	7935		—	1	21	—	22
Granite	8981		1	10	4	—	15
Leadville	10140		—	—	4	—	4
Minturn	7825		—	28	5	—	33
Monte Vista	7660		1	—	—	—	1
Pando	9209		—	1	3	—	4
Pueblo	4690	3	1	11	21	8	44
Salida	7050	—	4	16	15	3	38
Steamboat Springs	6680		—	2	—	—	2
Tabernash	8310		—	1	7	—	8
Toponas	8252		—	—	12	1	13
Westcliffe	7861		—	25	36	14	75
Yampa	7884		—	15	37	1	53
Total		8	34	311	403	71	827

WHERE LETTUCE GROWS BEST

Head lettuce in Colorado is a high-altitude crop. Experience has shown that elevations of from 7000 to 9000, or even 10,000 feet, produce the best lettuce. At these elevations the days are not often extremely warm and nights are uniformly cool, conditions that make for crisp, hard heads with a minimum of tip-burn and seed stalks. In certain seasons successful crops may be grown at altitudes of 5000 to 7000 feet, but the chances for a good return are much less than at the higher elevations.

Below is given a table showing the points from which head lettuce was shipped in 1922. The altitudes of the shipping points are given together with the monthly, carlot shipments in each case. Absolutely accurate figures as to shipments are very difficult to obtain. Those given in the table include not only the straight carloads of lettuce, but also many cars of mixed vegetables, of which lettuce made up the greatest portion.

A great deal of lettuce is shipped by express in small lots for which no data is obtainable. It is said that the Denver postoffice handled as much as 18 carloads of head lettuce by parcel post in 1922.

From the table it will be seen that the Buena Vista district, which is the oldest lettuce-growing locality in the State, still leads in production. Other districts are advancing rapidly, however, and a few years may see them take the lead. In some cases the altitude of the shipping point is much lower than that of the territory where the lettuce is actually grown. This is true of Pueblo, Florence and Eagle, which are from 500 to 1000 or more feet lower than the ranches which grow lettuce shipped from these stations.

The transportation factor is an important consideration in the development of the lettuce industry in any locality. A glance at the figures reveals that the most important shipping points are located on standard-gauge railroads where transportation and handling charges are less than elsewhere. Many localities in the State, where there are ideal climatic and soil conditions for the growing of the crop, are handicapped by lack of adequate transportation facilities and must grow lettuce in only a limited way, if at all.

Shipments from Salida include lettuce grown at Gunnison and Sargent. The lettuce grown at these points was loaded in field crates and shipped in box cars to Salida where it was packed for final shipment.

INFLUENCE OF SEASON ON LETTUCE GROWING

Head lettuce requires about ninety days from seeding to maturity. In some of the localities, at the higher elevations,

seeding cannot be done until the middle of June, while hard freezes may damage the crop late in September, if it is still in the field. This leaves no time to spare and the grower must be prepared to plant, cultivate, and harvest without delay when the time comes for these operations, or his crop will be a failure.

In the Canon City, Pueblo, and Denver districts, and in other localities with similar conditions, it is possible to grow two crops of lettuce on the same ground in one season. The early crop matures in June and the late crop in October or November. In the majority of the lettuce-growing localities the season is long enough to allow plantings to be made from May to July first with the harvesting of the crop extending over a corresponding period, but not sufficiently long to grow two crops.

The statement is often made that lettuce maturing late in the season, when the weather is cool, is more likely to be a success than the earlier crop. While this is perhaps true as a general proposition, it is of interest to note that in some years the earlier plantings have given the best results. With a comparatively cool summer during which seasonable rains occur, the early crop may head well. The prices for early lettuce are sometimes better than for the late crop, though often the reverse is true.

COMPETITION FROM OTHER SECTIONS

The states of California, Idaho and Washington all ship considerable lettuce of the "Western Iceberg" type during the months of June, July, August, September, and October, while other western states ship a much smaller quantity, the latter amounting in the aggregate to about one hundred cars in 1922. In the production of this type of lettuce, Colorado possesses advantages of location and transportation not shared by other sections producing the same kind of lettuce and should have no trouble competing with them.

New York ships heavily during this period and a considerable quantity moves from Michigan, Minnesota and New Jersey at the same time. The lettuce grown in these states is, however, of the "Big Boston" type and cannot compare as to quality with the Colorado product. It does, however, tend to depress the market in eastern centers as it sells at a much lower price than "Western Iceberg."

Colorado lettuce is favorably known in the large markets of the country and when of the best grade its quality is unsurpassed. Other states, particularly Idaho and California, also have a reputation for high-grade lettuce and in order to meet

competition from these sections successfully, Colorado growers should use every effort to produce a first-grade product. There is rarely a time that No. 1 lettuce will not bring a good price while the third-grade product is sometimes not salable at any figure. Poor-quality lettuce will, of course, due to various conditions, some of which are unavoidable, continue to be grown, but the amount of it should be reduced to the lowest point possible.

The following table shows the number of cars shipped during the Colorado lettuce season by the most important competing states in 1922.

CARLOT SHIPMENTS OF HEAD LETTUCE FROM MOST IMPORTANT COMPETING STATES, 1922

States	June	July	August	Sept.	Oct.
Western Iceberg					
California	390	184	100	91	221
Idaho	37	1	35	9	558
Washington	133	240	269	108	61
COLORADO	8	34	31	403	71
Big Boston					
Michigan	11	59	11		
Minnesota		13	38	26	8
New Jersey	42	3		1	151
New York	163	982	1006	667	351

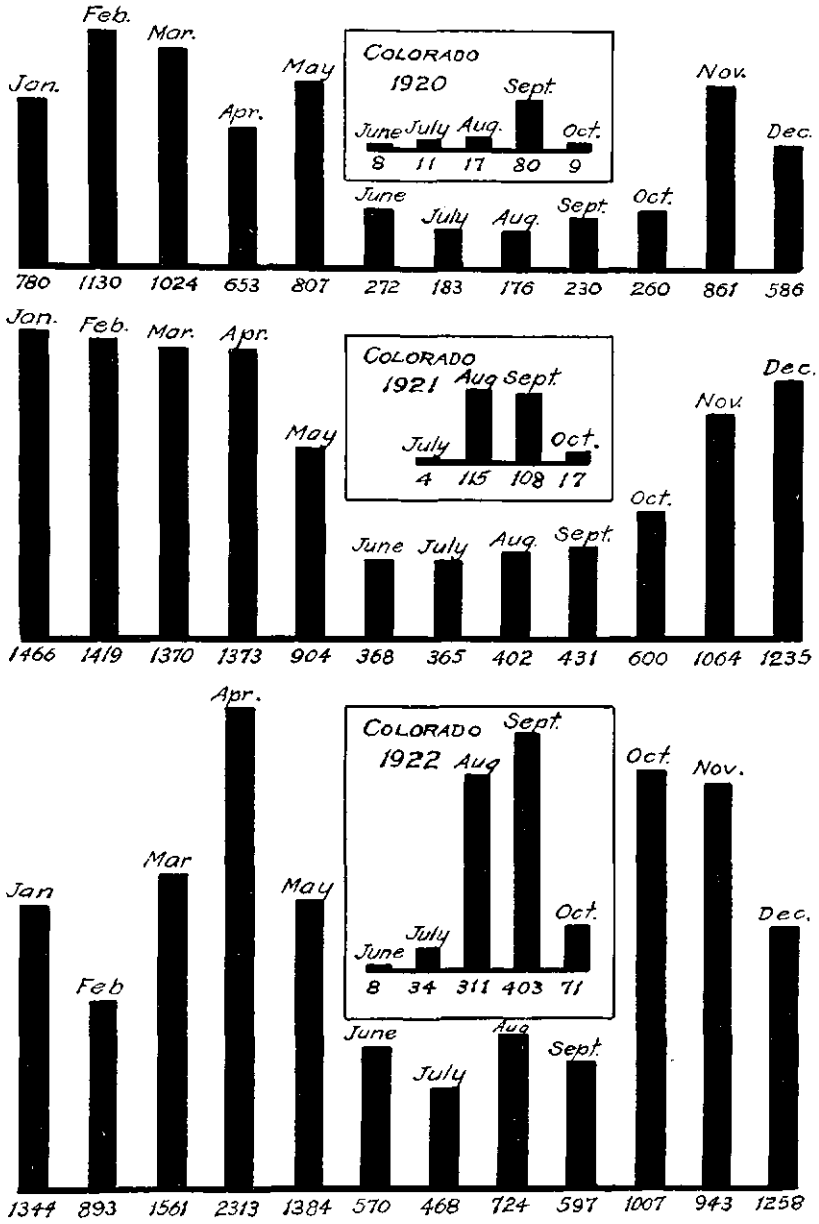
In this connection the distribution of the lettuce crop of the United States is of some interest. On the following pages the distribution of the crop for the entire United States, for the states producing "Western Iceberg," and for Colorado is illustrated graphically. These show that during the months of July, August, and September, when the bulk of the Colorado crop goes to market, the supply of lettuce is less than at other periods. This is probably a fortunate condition because, with the supply from home gardens and with an abundance of other green vegetables, there is not likely to be as great a demand for head lettuce as prevails during the late fall, winter and spring.

In the table below are shown the prevailing wholesale prices for "Western Iceberg" lettuce in some of the principal markets of the country. The prices shown are the averages of

WHOLESALE PRICES OF NO. 1 "WESTERN ICEBERG" LETTUCE AVERAGE FOR YEARS 1919, 1920, 1921 AND 1922

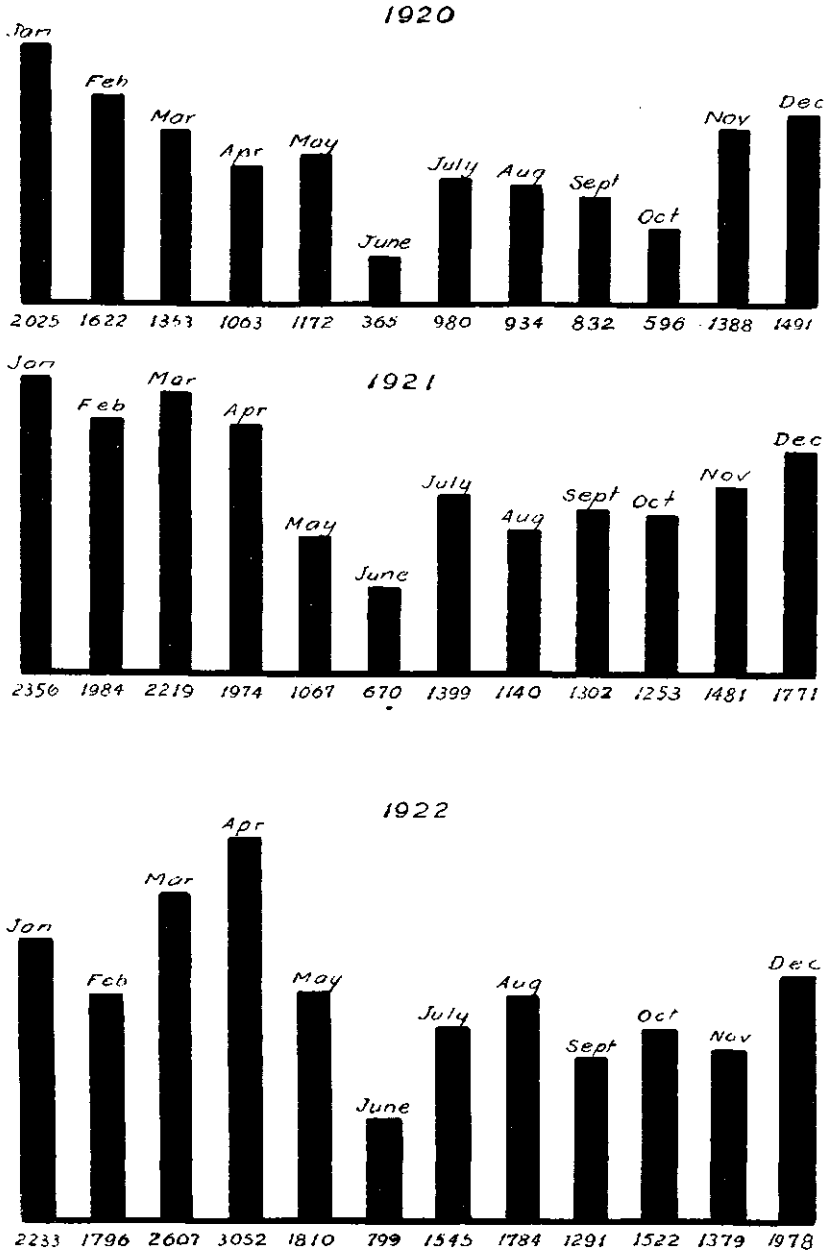
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Chicago	5.15	5.05	5.50	5.60	4.25	..	4.85	4.30	3.25	..	3.50	3.85
Cincinnati	4.25	3.95	4.25	4.70	3.80	4.00	3.65	3.20	3.25	3.25	3.50	4.25
Kansas City	4.00	4.50	4.45	4.95	4.20	3.50	5.00	5.05	4.50	4.85	4.70	4.35
Dallas	4.35	4.75	5.00	5.50	4.60	4.25	4.50	4.50	5.10	5.50	5.10	5.10
Pittsburg	4.50	5.30	4.30	4.75	5.85	3.85	2.95	1.85	2.35	4.00	4.75	5.00

DISTRIBUTION OF WESTERN ICEBERG LETTUCE.
MONTHLY CARLOT SHIPMENTS
1920, 1921 AND 1922



In the above charts are included figures for the states of Arizona, California, Colorado, Idaho, Oregon, Utah, Washington and Wyoming. The small charts for Colorado are drawn on a larger scale than the main charts. Note the advantageous position of the Colorado crop.

DISTRIBUTION OF HEAD LETTUCE—UNITED STATES.
MONTHLY CARLOT SHIPMENTS,
1920, 1921 and 1922.



In the above charts are included figures for both Western Iceberg and Big Boston letture. Note the relatively low supplies during Colorado season.

the prices which have prevailed during the past four years. The figures are not entirely complete but are the most accurate available.

Dallas and Kansas City seem to pay somewhat better prices during the Colorado season (June, July, August, September, October) than the other points. Their location is such that prices are not affected much by the heavy output of New York during these months, while the other markets, Pittsburg especially, are considerably influenced. On the whole, prices seem to fluctuate less from month to month than might be expected.

No prices are obtainable for No. 2 and No. 3 grades. The high percentage of these grades in Colorado last year was largely responsible for the low prices obtained, and it is doubtful whether it ever will be profitable to ship the No. 3 grade.

CULTURE OF HEAD LETTUCE

Soil and its Preparation.—Head lettuce is grown upon a variety of soils, but a dark, rich, loamy soil containing considerable leaf mold such as is found in areas from which aspens have been removed is usually preferred. Such soils always contain a good deal of sand and while one containing an excessive proportion of sand is usually to be avoided, such a soil may grow first-class lettuce. Light-colored soils do not, as a rule, give as good results as the darker ones, since they are apt to be poorer in plant food and the lettuce grown on them more subject to tip burn. Land with some slope is preferable to the level areas on the valley floor. This is especially true where there is danger of early freezes in the fall which will damage the crop on the low lands while more elevated and sloping grounds are likely to escape injury. However, the valleys often produce good lettuce.

The land should usually be plowed in the fall so that freezing and thawing during the winter will leave it in a good, mellow condition and so that manure applied before plowing, or other vegetable matter which is plowed under, will have a chance to become incorporated with the soil. If the soil cannot be fall plowed, then the plowing should be done as early in the spring as the ground can be worked.

In the work of preparing the land for lettuce, the grower should keep constantly in mind that he is dealing with a garden crop and therefore the soil should be put into the best possible shape. The surface should be left as fine as harrowing and dragging will make it, and should be leveled as well as possible. A survey of the lettuce fields shows very clearly that not enough attention has been given to these details in the past. A poor seedbed means poor germination of seed with the resulting poor stand of plants, and difficulty in cultivating the crop while the

plants are small, while land which is not level makes irrigation difficult and unsatisfactory.

Fertilizers.—The use of fertilizers in growing lettuce has not engaged the attention of any large percent of growers up to this time, but a few have tried them in a small way, and others are beginning to wonder if the use of some kind of fertilizing material would not be advisable.

In practically all cases beneficial results have been reported where manure was used. In experiments conducted last year at Buena Vista, the Department of Horticulture found that manure at the rate of twenty tons per acre caused the crop to mature considerably earlier and to head better than in the case where no manure was used. It was also found that nitrate of soda and sulfate of ammonia, both of which supply nitrogen, produced much the same effect when used at the rate of 200 pounds per acre. The results of one season are, of course, not conclusive and the experiments will be repeated.

A field of good lettuce nearing maturity.

The soils in the lettuce districts, especially those which have been cultivated for a few years, are apt to be lacking in both humus and nitrogen, so that the use of fertilizers, where obtainable, seems advisable. Manures supply not only plant-food materials but improve the physical condition of the soil, making it more friable, and should be applied in the fall and plowed under before the ground freezes. If put on in the spring, it should be well rotted. One grower reports good results where four

ordinary wagon-loads per acre were used. Probably better results would follow somewhat heavier applications.

The use of chemical fertilizers such as nitrate of soda, while apparently beneficial, is not recommended until tried out over a longer period. In the event they are finally recommended at all, they probably should not be used exclusively, but to supplement stable manures or some green manure crop which has been plowed under.

A crop of alfalfa or some other legume turned under in the fall prior to planting is desirable and is advised where possible.

Acreage to Plant.—The amount of lettuce planted by individual growers varies from one to 150 acres. There is a well-defined opinion that the majority of growers plant too large an acreage which results in some of the crop being neglected at certain stages. One man can look after five or six or more acres, depending upon conditions, except at thinning and harvesting time when help will be needed. In Idaho where boys are employed to do the thinning, one boy will thin an acre in about six days. It should be remembered that lettuce is a crop requiring the methods of the garden rather than the hay field and that one acre properly cultivated and irrigated may give a better return than ten acres poorly handled.

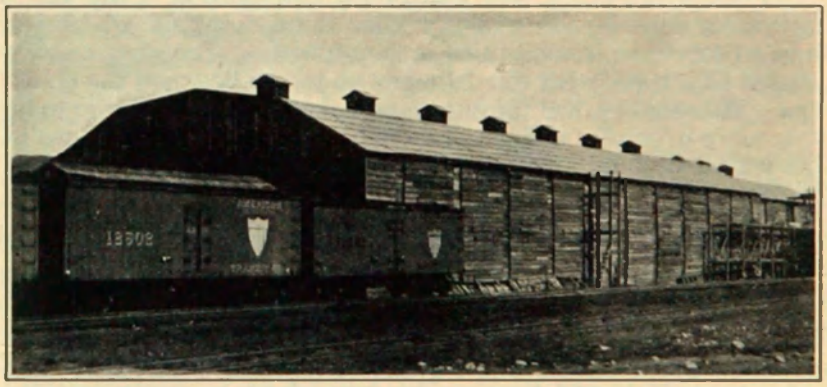
Varieties.—There is only one variety of head lettuce grown in the mountain districts and the correct name of this variety is New York, although it is known under other names, such as New York Wonderful, Los Angeles Market, and Mountain Iceberg. It belongs to the so-called crisp-head group of lettuce varieties, is dark green in color and the most desirable strain produces round heads. There are other strains, one of which is conical headed (the original type) and not considered so desirable. The name Iceberg, often applied to this lettuce, is a misnomer, as the true Iceberg variety differs from New York in being much lighter in color and in forming heads which are not so firm as those of New York. One seedsman predicts that the Iceberg variety will be grown considerably for the early crop at the lower altitudes as it is more resistant to heat at the time of heading, which with early lettuce takes place in June or early July.

Experiment has shown that many other varieties of head lettuce can be grown in Colorado but New York is the type demanded by shipper and consumer and the kind which should be planted in the mountain districts. On the plains where it is desirable to grow head lettuce for home use, varieties like Mignonette, May King, or Big Boston, the latter the popular shipping variety in the East, are more likely to form reasonably good heads than the variety New York.

Seed.—One of the greatest difficulties of the Colorado lettuce grower has been the inability to obtain seed of good quality. It appears that seed of the New York variety has been scarce and this may have resulted in some seed getting into trade channels which should never have been sold. At any rate a great percent of off-type plants can be found in most of the lettuce fields. One of the largest and best lettuce-seed growers in California has the following to say regarding the production of seed of the New York:

"New York lettuce is the most difficult variety we have to grow. Owing to density, the heads have to be opened to allow the seed stalk to come through. The variety is a very shy seeder and yields less than one half the seed of other sorts. Great care has to be used in harvesting as the seed shatters easily and a strong wind sometimes wastes a large portion of the crop of seed. New York lettuce was originally a conical-shaped type. By constant selection and working from individual selections we have developed a flat- or rounded-head type, making a larger and heavier head. This strain is extremely hard to fix."

They state, in addition, that they hope to have the type thoroughly fixed in another year or two.



Ice house built cooperatively by growers at Buena Vista. Capacity about 10,000 tons. The ice is used both in the crates and in refrigerator cars.

Growers should insist upon the best seed available as cheap seed is not likely to be worth the space it occupies. Prices quoted at the present time vary from two to four dollars per pound. With only a pound or a pound and a half required to the acre, the cost of seed is a small matter, considering the possible value of the resulting crop. If any doubt exists as to the germination of seed, it should be tested at home or a sample sent to the Seed Laboratory, Colorado Agricultural College, Fort Collins, where it will be tested without charge.

The question sometimes comes up as to whether or not the seed of plants which have formed seed stalks due to unfavorable weather conditions is suitable for planting. It is possible that such seed may prove satisfactory, particularly if the strain is known to be a good one, but it is believed that the best and safest policy is to use no seed except from plants which have first formed marketable heads of the desired type.

Planting.—At elevations of 7000 to 9000 feet where the bulk of Colorado lettuce is produced, planting is done during May. June, and the early part of July. Fall planting has been tried and while in some cases it has been successful, on the whole it appears not to have been satisfactory. From some of the milder sections of the State, as the Canon City district, some good reports have been received regarding this method. In fall planting, the seed is sown in October, and the plants make some growth before hard freezes set in. Being very hardy, they winter over satisfactorily and begin to grow with the first warm weather in the spring. Sometimes the seed is planted in the fall but does not germinate until spring, when it is ready to grow as soon as conditions are favorable.

The majority of growers favor the distribution of the planting over a considerable period rather than doing it all at one time. For example, one-third or one-fourth of the crop may be planted at a time, with ten days or two weeks between the plantings. This enables the thinning and harvesting of the crop to be done more promptly and satisfactorily as these operations are in this way distributed over several weeks instead of coming all at one time.

Spring planting at the lower elevations should be done as early as the ground can be worked so that the lettuce will have a chance to mature before extremely warm weather sets in. The late crop may be seeded in July and will mature in October.

Some growers advocate the transplanting of lettuce for the early crop. Transplanting can be done about as easily as thinning, a proper stand is assured, and if properly handled, the plants should head earlier, thus having a chance to avoid the hot weather. When handled in this manner, seed is planted in a hotbed February 15 to March first and the plants are set in the fields about the middle of April. Before transplanting, the plants should be hardened by gradually exposing them to outside conditions by raising the sash of the hotbed.

The amount of seed to plant depends upon the quality of the seed and upon the condition of the soil at planting time. With good seed and the best of conditions for germination, one pound, or even three-fourths of a pound of seed per acre is considered

sufficient, while one and a half or two pounds may be required under more adverse conditions.

Seed is sown, as a rule, with some type of seed drill, those of the Planet Jr., Iron Age, and Iron King type being most used. These may be operated by hand, or they may be rigged up so that a horse or small garden tractor can pull two, three, or four of them, thus planting two to four rows at a time. Instances are known where beet planters have been used, the seed being mixed with sand, one pound of seed to thirty pounds of sand, to facilitate even planting.

Planting Distances.—A questionnaire sent to growers shows that the majority prefer distances of from twenty to twenty-four inches between rows and from twelve to fourteen inches between plants in the row. Some, however, specify a distance of twenty-six to thirty-two inches between rows. The greater distance between rows allows the use of one-horse cultivators to better advantage than where rows are closer together. Planting is sometimes done in double rows, furrows being laid out from thirty to forty inches apart and a row planted on each side of the furrow. The rows of each pair are about twelve or fifteen inches apart and the space between the pairs of rows about eighteen to twenty inches wide. The latter space is cultivated throughout the season. The narrower space is used for irrigating and is cultivated after each irrigation the first of the season, but later, when the plants begin to occupy the space, is left alone.

Seed should be covered one-half to one inch deep depending upon the season, soil and moisture conditions. The depth of planting should be shallow if done early in the season when the soil is cold and damp, and deeper if done later when it is warm and dry. In light sandy soils the seed may be put deeper than in heavier types.

Cultivation.—Observations indicate that lettuce requires more cultivation than is usually given it in Colorado. Growers differ as to the number of cultivations which should be given, some believing that two or three are sufficient while others recommend "one cultivation a week," or "frequent cultivations" or "cultivation after each irrigation." Still others think that from four to six cultivations will produce a successful crop. The Idaho Experiment Station recommends a cultivation once every week or ten days. Lettuce responds to frequent cultivation and it is hard to overdo it.

Where the soil has been properly prepared, cultivation need not be deep. What is needed is to stir the surface soil so as to kill weeds and form a dust mulch. In many cases this work is done with a hand cultivator, or wheel hoe which stirs the soil

to a depth of about two inches. In other cases horse-drawn cultivators are used.

Cultivation after irrigation and after rains is especially important as it prevents the soil from baking and conserves the moisture. The leaves of lettuce are very brittle early in the morning and on cool, cloudy days. When the plants have reached good size, it is probably better to delay cultivation until the day is somewhat advanced as the leaves, due to the warmth and lessened turgidity, will not be so likely to be broken off when brushed by the cultivator.

Tools.—Some growers are using beet tools in handling lettuce with very good results and it is believed that they are worth a trial by others since they offer the possibility of doing the same amount of work in less time. To use such tools successfully the ground must be in reasonably good condition and rows must be straight and a uniform distance apart. Besides facilitating cultivation, level ground and straight rows will also make irrigation and other operations less difficult.

Hand seeders and hand cultivators have been popular so far in the lettuce fields, but there seems to be a stronger sentiment developing in favor of horse-drawn tools. For small areas, where land is valuable and intensive culture desirable, the hand tools are very satisfactory but for larger operations, the work is more easily done with horse power. One-horse cultivators of the seven-, nine- and twelve-tooth types are well adapted for use in the lettuce fields. There are also one-horse cultivators, adapted to lettuce culture, on the market, which cultivate two rows at a time.

The newer models of light garden tractors seem to be fairly well adapted to this class of work. They have been tried to a limited extent and while their value has not been entirely proved they show some promise. Some makes are provided with seeding attachments which will plant two or three rows at one time. These machines can also be used for other work around the ranch, such as pumping, grinding, etc.

Thinning.—This is one of the most important as well as one of the most laborious operations connected with lettuce growing. It is a case where the cultivator must literally assume a prayerful attitude and get down on his knees to do the work properly. The small plants stand close together in the row and to avoid injury to the ones left, the others must be carefully removed. Only one plant should be left in a place and the work should be done when the plants have developed only three or four leaves, or before they tend to become spindling. A plant every twelve or fourteen inches is close enough on good soils. Hoes, knives and tablespoons are used in thinning.

Irrigation.—There is a great deal of difference of opinion as to how lettuce should be irrigated. The majority, however, is inclined toward the view that frequent, light irrigations are best. Thorough soakings when the plants are small may do no harm, but only light irrigations, frequent enough to keep the soil always moist, are advisable as the crop nears maturity. Water can often be run in every other middle at one irrigation and in alternate middles the next time. Night irrigation is practised by many growers, especially during hot weather and when there is danger from freezing.

It seems hardly necessary to say that water should always be applied in furrows but cases are known where the flooding method has been used either through ignorance or because the land was not sufficiently well leveled to avoid it. Where this method is followed the plants are frequently covered with mud and when the ground dries out after irrigating, the surface is left in bad shape due to baking.

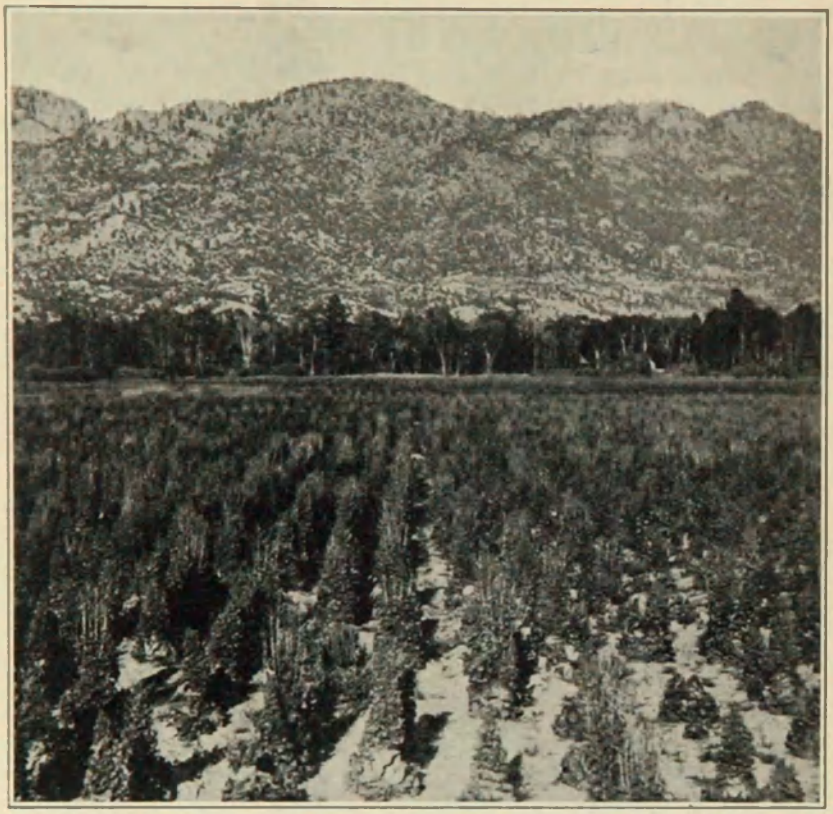
Crops of good lettuce have in some instances been grown under dry-farming conditions in localities where the rainfall is above the average for Colorado, but the extreme uncertainty of producing a profitable crop under such conditions should cause prospective growers to select sites where there is plenty of water for irrigation.

Shooting to Seed.—At times lettuce growers experience great losses from the plants shooting seed stalks before forming good marketable heads. This trouble has been ascribed to unusually warm weather which sometimes prevails during the maturity of the crop and which no doubt does influence it to a great extent. Other factors, however, such as a poor strain of seed, improper irrigation or lack of cultivation probably have a good deal to do with the trouble.

When a lettuce plant forms a head the next step, normally, is to produce a seed stalk. The head may stand for several days, under ideal conditions, without shooting to seed, but in hot weather, the seed stalk may begin to form before the plant has made a firm head. In many cases the trouble is not evident until the head is examined, when it may be found that the seed stalk has already grown considerably and is curled up inside the head. Such heads are usually characterized by a bitter taste and should never be packed for market.

Cultural methods which avoid any check in the growth of the lettuce and the planting of as good a strain of seed as can be obtained should aid in reducing losses from shooting to seed.

Diseases and Insects.—Tip burn is the most serious disease



Field of lettuce after "shooting to seed,"—one of the worst troubles the grower must contend with.

of lettuce in Colorado, some loss due to it being reported every year.

The January, 1922, bulletin of the California Department of Agriculture contains the following discussion of this disease:

"Severe losses are sometimes occasioned by tip burn, which is characterized by the blackening of the edges of the inner leaves and which, under favorable conditions, will result in a partial or total decay of the interior of the head. It is, however, often impossible to detect any external symptoms of this condition. The disease is of a non-parasitic nature and the damage is usually done after the plants have started to head. It is most prevalent when bright, hot weather follows a period of cloudy or rainy weather. Considerable variation of infestation is found in the different classes of soil. Lettuce growing in soils of high

water-holding capacity shows less injury than that grown in soil with an insuffiicient supply of moisture. In the Imperial Valley this disease seems to be closely related to alkali conditions. Slimy soft rot will often start in the weak tissues caused by tip burn, while the lettuce is being shipped or held in storage, causing total loss of that head. Heads which are only slightly diseased will invariably develop a bitter flavor."

Lettuce affected with tip burn should of course not be shipped as the bitter taste is disagreeable to consumers and the heads are quite apt to go to pieces in transit.

Good seed and good culture are the best remedies known for this disease. Frequent, light irrigations are recommended by some during hot, dry spells. It may be possible to develop a strain of lettuce which will be resistant to tip burn and experimental work with this object in view is already in progress.

The disease known as "slime" is apparently caused by decay organisms gaining entrance to the head through other injuries such as tip burn, or bruises caused from feeling of the head to determine whether it is firm or not. Insect injuries may possibly furnish a means of entrance for the germs of decay. This trouble produces a slimy rot which in a short time makes the head totally worthless. It may cause the deterioration of lettuce after it has been started on its way to market and is one reason why heads showing signs of tip burn, or known to be affected with it, should not be shipped.

Another disease sometimes known as "rust" seems to be a form of tip burn.

The only insects which have been reported as damaging lettuce are cutworms and wireworms. These pests sometimes occur in sufficient numbers to do real harm to the crop. The identity of the harmful species of both cutworms and wireworms is somewhat in doubt and since the different species require different treatment it seems best to omit specific directions for combating them. It is at best difficult, if not impracticable, to control them. Growers having trouble with these or other insect pests should send specimens of them to the Department of Entomology, Colorado Agricultural College, Fort Collins, together with all information possible regarding their numbers, the length of the period during which they are observed damaging the plants, previous crops grown on the land, and any other data which may have any connection with them.

Certain species of cutworms and wireworms have been effectively destroyed by the use of poison-bran mash which is

prepared according to the following formula found in Colorado Experiment Station Bulletin 210, Insects and Insecticides:

Paris green	3 pounds
Bran	50 pounds
Syrup (cheap)	4 quarts
Water	5 gallons
Lemons	10

Mix the Paris green and bran together while dry; dissolve the syrup in the water; squeeze the lemons into this and finely chop the peel and pulp and add them also; pour this mixture into the bran and Paris green, and stir so as to dampen the mash thoroughly. The lemons may be prepared by putting them through a meat grinder. Distribute the mixture broadcast in as fine particles as possible where the worms are most abundant. The application should be made towards the evening or early (between 4 and 7 o'clock) in the morning. From 3 to 5 pounds of dry bran is usually sufficient for an acre of land. Never distribute in little piles.

Harvesting, Grading and Packing.—These operations deserve much attention and care since the final results of the season's work may, in a large measure, depend upon them.

Harvesting should be done in the morning when the heads are cool and crisp, but, according to California authorities, the heads should not be cut while wet or when frozen as they are then much more susceptible to subsequent heat or rot.

It is necessary to go over the field about three times in harvesting the crop, so that the lettuce may be cut as soon as it is ready. Prompt cutting of matured heads is important during warm weather, but after the days become cool, cutting may be delayed somewhat if necessary.

The plants are cut just below the head in such a way that all the leaves are left intact. One who is experienced in harvesting lettuce can tell at a glance what heads are ready to cut. The heads are put into field crates as soon as cut with the bottom of the head up, and should be taken to the packing shed at once. Everything possible should be done to keep the heads cool and prevent wilting by sun and wind. Putting crates in the shade as soon as filled or covering with canvas will be of advantage in this particular.

At the packing shed the lettuce is trimmed, graded and packed into crates which are at once loaded into refrigerator cars. The standard crate used in Colorado is what is known as the Los Angeles crate and measures 13x18x24½ inches. The crate is lined with paraffin paper and the heads packed two to

A lettuce-packing shed. Note the cull lettuce on platform at right of picture.

four or even five dozen to the crate, depending upon the size of the heads. Crushed ice is placed between the layers of heads in the crate, about 35 or 40 pounds being used for this purpose.

Many growers are beginning to recognize the need for strict grading of the lettuce shipped and urge that a high standard be set. In 1922 the Standard U. S. grades were in force in Colorado, all cars being duly inspected before shipment. The following specifications for head-lettuce grades are taken from a booklet entitled "Standardization of Colorado Fruits and Vegetables," published by the Colorado Division of Marketing, July 1, 1922:

U. S. GRADES FOR HEAD LETTUCE

U. S. Fancy No. 1

U. S. Fancy No. 1 shall consist of heads of lettuce of similar varietal characteristics which are fresh, well trimmed, and firm; which are not wilted, decayed, or burst, and which are free from seed stems and doubles and damage caused by freezing, tip burn, disease, insects, or mechanical or other means.

Each head of lettuce shall weigh not less than one pound.

U. S. No. 1

U. S. No. 1 shall consist of heads of lettuce of similar varietal characteristics which are fresh, well trimmed and fairly firm; which are not wilted, decayed or burst, and which are free from seed stems and doubles and from damage caused by freezing, tip burn, disease, insects or mechanical or other means.

Each head of lettuce shall weigh not less than ½ of a pound.

U. S. No. 2

U. S. No. 2 shall consist of heads of lettuce of similar varietal characteristics which are fresh, well trimmed, and which are free from seed stems and from damage caused by freezing injury, tip burn, disease, insects or mechanical or other means.

Each head of lettuce shall be of merchantable size.

In order to allow for variations incident to proper grading and handling, not more than 10 percent by count, of any lot of the above grades may be below the requirements of the grade, but not to exceed one-half of this tolerance shall be allowed for any one defect.

U. S. No. 3

U. S. No. 3 shall consist of heads of lettuce which do not meet the requirements of any of the foregoing grades.

Definition of Terms

"Similar varietal characteristics" means that the heads in any container have the same color and characteristic leaf growth. For example, lettuce of the Iceberg and Big Boston types must not be mixed.

"Fresh" means crisp and green.

"Well trimmed" means that the head is protected by green wrapper leaves, but excessive wrapper leaves and those which have been noticeably injured by decay, worms, tip burn or other means must have been removed.

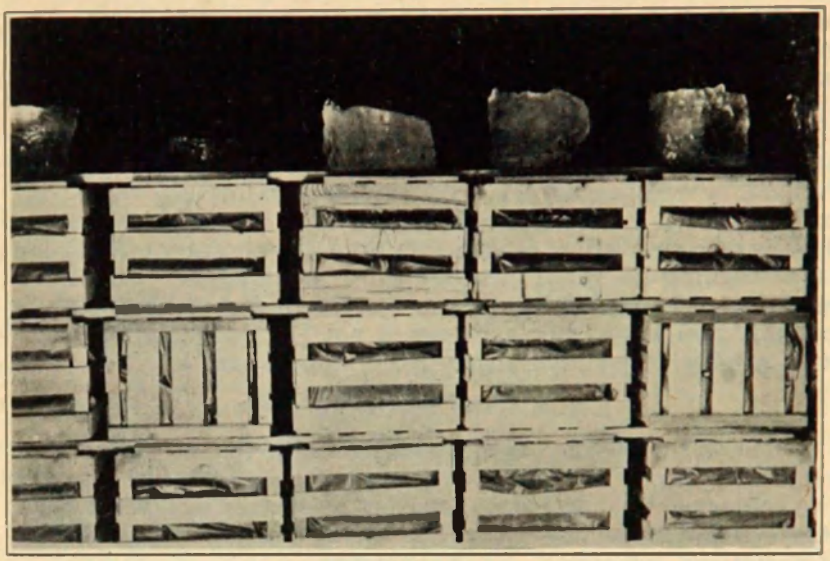
"Firm" means that the head is compact and feels solid.

"Seed stems" means those heads which have seed stems showing or in which the formation of seed stems has plainly begun.

"Fairly firm" means that the head yields readily to pressure but is not soft or spongy.

There is no question but that the strict enforcement of grading standards will do as much as anything to put the Colorado lettuce industry on firm foundation. It is of interest, in this connection, to note that figures of the Division of Marketing covering 537 straight carloads of lettuce inspected in 1922 show that only forty percent graded U. S. No. 1 while sixty percent was under this grade. The statement is made that the percent of No. 1 lettuce would have been higher had it not been for the indiscriminate mixing of different grades in the crates. which lowered the grade of the whole lot. The lettuce of 1922 was of course of somewhat poorer quality than in other seasons, due to unfavorable weather conditions.

Marketing.—The handling of lettuce after it reaches the packing shed is usually done by some marketing agency. Such agencies may be organizations composed of growers or they may may be private concerns. They operate the packing sheds, furnish crates, and do the grading, packing, loading and marketing. They often contract to handle the grower's crop charging a certain price for the service. In 1922 one grower's organization charged $1.00 per packed crate for packing and marketing the lettuce. In addition to the above-mentioned services, some of the agencies handle seed and other supplies which are sold to the growers whose output they handle.



Car of lettuce showing method of loading. Chunks of ice are placed on top of each crate in upper layer

It is important that the grower make some arrangement in advance for the marketing of his crop. Cash buyers are sometimes glad to pick up a few cars at a good price, but cannot be depended upon to handle the entire crop, and this is especially true when the supply of lettuce is plentiful. The established organizations or agencies cannot be expected to take care of the grower at such times, when he has not favored them at other times. A reliable agency should be selected by the grower to handle his product and agreements and contracts should be faithfully fulfilled by both parties.

The marketing of Colorado lettuce should be considerably improved in the next few years. Better distribution of the crop seems possible and should be investigated. A better-quality product made possible by better-informed growers, together with more strict grading and packing should result in better returns to the grower.

Prices and Yields.—Two large shippers report that the average prices paid the grower in 1922 were $1.50 and $1.64 per crate, respectively, after all packing, transportation and marketing charges were deducted. These prices are considerably lower than those of 1920 and 1921 which, according to one shipper, averaged $2.42 and $2.21 respectively.

In reply to a questionnaire, growers report net prices ranging all the way from $.75 to $2.00 per crate for the 1922 crop.

Yields have been so variable, due to lack of knowledge regarding the crop, weather conditions and other causes, that it is hard to arrive at an average figure. Some have cut 500 or more crates to the acre while others have harvested none at all. Of the 6000 acres reported to have been planted in 1922, probably 5000 acres were cultivated until heads or seed stalks were formed. From this acreage, 827 cars, approximately, were shipped, or a little more than one carload (350 crates) to six acres. This is of course a low average per acre (about sixty crates) but is a warning to those just entering the field not to set the probable yield too high. It would seem that a yield of 200, or possibly 300 crates per acre would not be too much to expect with good soil and favorable weather conditions.

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