



UNIVERSITY
OF ARIZONA
AGRICULTURAL
EXPERIMENT STATION
TIMELY HINTS FOR FARMERS

No. 128

AUGUST 15, 1917

HEAD LETTUCE GROWING IN SOUTHERN ARIZONA

INTRODUCTION AND HISTORY

It has been known for a number of years that good head lettuce may be easily grown in Southern Arizona. It was not until the winter of 1913-14, however, that the crop was grown in car load lots for shipping to distant markets. Mr. J. S. Heard grew three cars this winter on his farm near Phoenix most of which was shipped to Chicago. The returns from this crop were very satisfactory, being something over \$200 gross per acre. This effort attracted the attention of cantaloupe growers because it promised to give them a profitable winter crop which would not interfere with cantaloupes. A number of factors contributed to the failure of the crop of 1914-15 grown by these men. It did not mature until warm weather, when it was hard to handle. Cars, also, were packed too full in the effort to get the minimum of 20,000 lbs. in a car, and, while the lettuce which reached the market in good condition sold for a good price, the returns on the whole showed a decided loss.

The season of 1915-16 was much more satisfactory. Profiting by previous experience lettuce was produced and marketed at a decided profit at the same time that Southern Texas growers of this crop were sustaining losses. Twelve cars were shipped from the Glendale district the average net returns from which were in the neighborhood of 70c per crate to the growers. Since 300 crates can be cut from a well cared for acre, this price gave a good margin of profit.

The success of the 1916 crop was a stimulus to increased planting. Many farmers who had not grown lettuce before joined the United Produce Growers' Association of Glendale and raised an acreage. Although a heavy rain in September *tidydsA*, planting, and the winter was cold, the season was *tidydsA* ful for the new industry. Ex-

cellent prices were received. One car sold for four dollars per crate on the New York market.

Climatic requirements and possibilities for extension While lettuce planted in the fall will survive ordinary winters in Southern Arizona at most elevations under 4000 ft., the crop will be most successful as a truck crop in districts that are warm enough or almost warm enough for citrus fruits. Such areas in Arizona include parts of the Salt River, the Lower Gila and the Colorado River Valleys. The Imperial Valley of California is a continuation of this area. The reason the area named is better suited to the production of winter head lettuce as a truck crop is, chiefly, because of the higher winter temperatures, with a resulting earlier crop. There is less competition on the market during the early months of the year than later, although satisfactory prices have been received as late as May.

Arizona lettuce comes in competition with head lettuce from the Gulf states which should and usually does excel. The ability to control the water supply is an important factor in lettuce production. Rain is often the cause of fungus troubles and if rain falls on a solid head of the crisp type the head opens up. The light rainfall during the winter season, the cool nights, and the warm bright days of Southern Arizona give this section the best winter lettuce growing climate in the United States. There is no reason why all the big markets of the country should not be supplied in season by "hard as cabbage" New York head lettuce, grown in Arizona.

The future extension of the industry will be governed largely by available markets. The demand may be increased by advertising or by shipping cars of mixed vegetables. The latter plan is much the better at the present time. Roughly speaking a market will use at good prices to the grower about one car per week for each 100,000 inhabitants, but such a market would rather have that amount in installments twice a week than all at one time. Mixed cars would accomplish this very nicely and there is promise of as great profit in other lines of produce as there is in lettuce.

CULTURE

Preparation for lettuce growing: Plowing under a crop of cowpeas or alfalfa in midsummer is as good preparation as lettuce land can receive. By planting time the vines will be so decomposed that they will afford a strong stimulus to the lettuce. If planting cannot be done so early Tepary beans will make a better growth in the hot weather. The advantage of fertilizing with a cover crop is the absence of weed seed on the land. Because of weed seeds in manure many growers do not like to use it. This trouble can largely be corrected by piling the manure in low piles with a basin in the top for water. The manure will be rotted in a few months so that no weed seed will be viable. If the manure is piled along the head ditch and wet by bailing water out of the ditch into the basin often enough to keep it moist but not wet the composting will be very little trouble. Composted manure can be applied at any time without damage to the crop. It can be plowed under at the rate of 20 tons per acre or it can be applied as a top dressing, but should not get into the young plants.

No soils are benefited more by manure than desert soils and it is

safe to say that no state wastes a higher percentage of manure than Arizona. The idea that manure burns crops comes from the fact that decomposing manure requires water but after decomposing the manure helps to hold moisture.

Commercial fertilizers: Commercial fertilizers should be used only to supplement a cover crop or composted manure. If cantaloupes and lettuce are both to be grown on the land it is a good plan to apply the fertilizer to the cantaloupes. A satisfactory fertilizer for lettuce to supplement composted manure or a cover crop is one carrying 6-8 per cent of nitrates, and 8-10 per cent of acid phosphate. This mixture should be used at the rate of 500 lbs. to 1000 lbs. per acre applied before planting. To stimulate a crop for early market, applications of 100 lbs. of nitrate of soda per acre applied every 2 or 3 weeks will accomplish the purpose. Nitrate of soda should not be used in the fall later than six weeks before killing frost is to be expected because it induces a rapid succulent growth easily damaged by frost.

Method of planting: In the Lower Colorado Valley and to some extent in the Salt River Valley it is the practice to plant two rows of lettuce 12 inches apart on ridges 3 to 4 feet apart. Most lettuce in the Salt River Valley is planted in single rows on ridges 22 inches to 30 inches apart. A very little lettuce has been grown by flooding, in rows planted 18 inches to 30 inches apart. In order to test the desirability of the three methods, a plot of each was planted on the Salt River Valley Farm. From this planting and from observation the following conclusions are drawn concerning these three methods:

For intensive culture of lettuce on high priced land when the planting is done after October first, two rows on the ridge is a desirable method. This requires more handwork, but gives a yield of more heads per acre. These will be of good size on well fertilized land. It is a little more difficult to obtain a stand in warm weather with the double row system than it is with the single row system because the ground cannot be kept as moist and consequently is not as cool as with the single row system.

The single row system is to be preferred for early planting and in general where the most intensive cultivation is not desired. It requires less labor in cultivation, irrigation is easy, and this method has given general satisfaction. High ridges are to be preferred to low ridges. Lettuce is injured by having its foliage wet, so that it is much better for the moisture to rise through the soil to the plants than to flood them.

While on light well drained soils flooding may be fairly satisfactory most years, yet there is the danger that diseases such as lettuce drop may in wet seasons take off most of the crop. This system cannot be recommended.

Preparation of the land: If a crop of cowpeas has been plowed under by midsummer, lettuce land need only be harrowed, leveled, and ridged before it is ready for planting in the fall. If manure is applied it is very desirable to disk this into the soil before plowing. Better distribution of manure is secured in this way and the capillary rise of moisture is not broken by a layer of loose manure otherwise left in the soil. The land should be extremely level. One can afford to neglect any part of the work more than the leveling. With rough

land it is practically impossible to secure an even stand of plants and even though secured it is difficult to mature the crop evenly.

Ridging is done by means of a single shovel cultivator, a double mold board plow (a lister), or by means of disks on a beet cultivator. Of the three implements, the lister does the best work. It makes high ridges which can be dragged down to a good seed bed. If, however, the cultivation is to be done with a beet cultivator it is best to throw up the ridges with the same implement in order to have the rows properly spaced for cultivation later on. The beet cultivator however, does not throw up as high a ridge as it might.

After the ridges are made a drag will finish off the top ready for the drill. For the beet cultivator a four row marker should be run down the ridges in order to get the rows properly spaced for cultivation. The straighter the rows the easier and better the cultivation will be.

Varieties. The two leading types of head lettuce grown are the butter head, and the crisp head. In addition to these two types there is the Cos lettuce which forms an elongated head. The type which develops the highest quality in Arizona is the crisp head. The butter head type yields good solid heads, yet they are inferior to the crisp head type. The structure of butter head lettuce is such that most of the leaves are exposed to the dry atmosphere and they are consequently tougher and contain less water than the crisp type which has all but the few outer leaves fully protected. Each leaf of crisp lettuce envelops almost the entire head. On the other hand nearly every leaf of the butter head type is exposed, in part at least, to the atmosphere. The leading commercial variety in the crisp type is the New York Market, known also as Los Angeles and as Wonderful. It has a darker green leaf than most of the other crisp lettuces. It forms large sized heads of good quality, although rather coarse in texture. Heads weighing three pounds are not uncommon in this variety. It is the variety which will establish 'Arizona's reputation as a lettuce producing state. It is popular on the Western and Middle Western markets and is acceptable on most of the Eastern markets. Big Boston sells for high prices at times on our eastern markets. This may warrant planting a small acreage of this variety. Big Boston will give better results in wet weather than New York because it is a humid climate lettuce. Other varieties of the crisp type which are fairly satisfactory are Iceberg, Denver Market, Hansen, and Brittle Ice. Brittle Ice seems to be an excellent variety for home use. Iceberg is the most heat resistant of the crisp lettuces. The Cos varieties have not given very good results. White Paris is as satisfactory as any of this type. Varieties of the butter head type which have been successful are as follows: Sensation, Long Island, White Normandy, Stonehead, Market Gardener's Private Stock, and St. Louis Butter Head.

A test of the New York variety from different seed houses leads to the conclusion that there is little choice in the seed offered by different houses except in the matter of germination. Seed varies in this particular a great deal, showing the desirability of testing samples of seed before planting. Place the seed to a blotter, cover with another blotter and put the two ^{fe^wte?} ~~two dinner plates one~~ inverted over the other. A very little ^{fe} ~~in the~~

lower plate. The inverted plate is for the purpose of preventing evaporation. This test can be read the fifth day or two readings can be taken, one the third day, the other on the fifth. If a hundred seeds are used the number germinated will be the per cent of germination.

Planting: Most of the trouble in securing a stand comes from not having the land properly leveled. With unlevel land irrigation is necessary to show where the water comes, but if one knows that the land is level dry planting requires less work and is just as satisfactory as planting after irrigation. If planting is done in hot weather a good portion of the seed will rot in the ground, or, should a stand be secured too early the crop will shoot to seed before heading. September 15th in Southern Arizona usually gives the earliest possible crop. Earlier planting in some seasons may be satisfactory but the earlier the planting the more difficult it is to secure a stand.

The best time for commercial planting is between September 15th and November 15th. Later planting than this may give good results, but the crop maturing early in the year generally gives better financial results than later lettuce. It takes about 90 days of good growing weather to mature a crop of head lettuce. Cold weather will add to the time, because, with frosty nights little or no growth takes place and in severe weather the leaves may be frozen back even to the ground. The crop on the Salt River Valley Farm was frozen back in 1916 by a succession of cold nights in December, but the plants came out of the freeze and matured a fair crop during the latter part of March and the fore part of April. Had the plants been a little larger when cold weather came they probably would have withstood the freezing weather better. Temperatures as low as 19 degrees were recorded on the farm. A few of the plants that were frozen back showed a tendency to stool out rather than to make one head.

Thinning: Thinning lettuce is the most laborious process connected with lettuce growing. The earlier it is done the cheaper it is done. As soon as two or three true leaves of the plants appear thinning should begin. If the seeding has been done with a good drill and good seed used, not to exceed one pound per acre, the thinning can be accomplished at this time with a minimum amount of work. Later, several plants will crowd together so that it is impossible to tell at a glance how many there are. Most of the work of thinning can be done with a hoe. In many cases single plants can be chosen to remain. This obviates the necessity for further thinning. The hoe work should be done first and the hand work done later, but in all cases it is advisable to rush the work as much as possible. The hoe thinning will provide better growing conditions for the plant but unless the hand thinning follows shortly the work will be much greater on account of having to spend time to ascertain the number of plants in the bunch. If more than one plant is left a marketable head will not be produced in most cases. Delayed thinning may result in the loss of as much as a month's time. Some growers take advantage of this to secure a succession of crops without making successive plantings; but the added labor by this method makes successive planting much more desirable where it is desired to extend the season. In thinning, 9 in. to 12 in. is left between each plant.

Cultivation and irrigation Lettuce forms a tap root with numerous small lateral roots that come very close to the surface of the soil. This should be borne in mind in cultivating the crop, the object being not to break these lateral roots, and to protect them from exposure by the drying out of the soil. When the plants are very small, deep cultivation can be given. This is desirable to keep the ground loose for the reception of the roots, but as the plants increase in size the depth of cultivation should be decreased. A fourteen tooth cultivator is a very satisfactory implement in cultivating lettuce. A five tooth cultivator with small teeth is good provided the teeth are not run too deep after the first two cultivations. It economizes labor to run a shovel in the rear to open up the irrigation furrow and to cover up the roots which may be exposed. It is not desirable to throw dirt into the heads during cultivation. That is one reason why small teeth should be used on the cultivator. Some growers use a beet cultivator for the crop. This may be advisable in some cases as it can be made to save a good deal of labor, but the time which it takes to cultivate is not great in any case. Unless the labor of cultivation interferes with some other important work it is probable that it does not pay to incur the expense of equipping with a beet cultivator.

Irrigation Although lettuce is composed of over 90% of water it does not require a great deal of irrigation. It grows during the cold season when a little water goes a long way, and the character of head is such that evaporation or transpiration occurs only from the outer leaves. In warm weather it is advisable to irrigate as often as possible, to reduce the temperature of the soil. Irrigation every four days is none too often at this season. In hot weather night irrigation is preferable to day irrigation as the hot sun and water will scald the young plants. Later, when the weather is cool and the plants larger, day irrigation is better because the water is warmed and does not check the growth by chilling the plants. At this season an irrigation every 8 days is ample and frequently longer intervals than this are possible on account of rains. It is much better to have the irrigation water rise to the plants than to surround the plants. Therefore, a small head run for a long time in a furrow gives much better results than a large head for a short time. Irrigation in alternate furrows, wetting only one side of each row, will give ample moisture in cool weather. Obviously cultivation should follow each irrigation at the proper time.

Few insects and diseases are troublesome to lettuce in Arizona.

INSECTS AND DISEASES.

It seems strange that leaves so palatable to human beings are not attacked more by insect pests; but except for occasional damage to early plants by grasshoppers, slight damage from cabbage worms, and very light attacks by aphids, the grower of lettuce does not have to contend much with insects. When lettuce is planted close to alfalfa fields damage is liable to occur from grasshoppers from the alfalfa. A control measure generally recommended is the use of bran mash prepared by mixing 20 pounds of bran, one gallon of cheap molasses, 3 to 5 chopped lemons, and one pound of Paris green. This should be scattered around the field before daybreak. Applied later in the day the mash dries out quickly and is not eaten so well by the grasshoppers.

Lettuce drop is the only disease which has been observed so far.

It generally attacks the maturing heads during wet winter weather causing a black discoloration. This disease may be bad where water from a waste ditch floods a field. Where such is likely to occur it is a good plan to plant some other truck crop such as spinach, or carrots.

HARVESTING AND PACKING.

Early in the season growers are tempted to ship too early on account of prospects for high prices. This does little good because the yield is reduced when the crop is cut too soon.

A low wagon or a stone boat is good for gathering the crop in the field. Each man of the crew can handle two rows to advantage. If the packing is done on the farm there is no need to use lug boxes because the heads can be trimmed from the wagon and thrown onto the packing tables. If there is a central packing house it is more convenient to use lug boxes. It saves work and crop if only mature heads are cut.

California growers use a crate which holds three layers of lettuce. It is quite likely that a smaller crate may be used to advantage. This is indicated by the higher proportional returns that Arizona lettuce has brought in crates holding 2 layers. The Arizona crate is 18 in. by 22½ in. by 8½ in. inside. These hold anywhere from 24 to 48 heads, depending upon the size of the heads.

Good head lettuce weighs as high as 50 lbs. to the iced crate or nearly as much as a box of apples. The crate therefore must be strong and well nailed with cement coated nails.

The lithographed label on the crate of the United Produce Growers' Association probably adds 25c to the selling price of a crate. Fruit growers in general feel that they cannot be without labels and without doubt this also applies to vegetable growers.

All crates should be lined with wrapping paper to prevent drying out and contamination in express shipments. If the work on the outside of a package is poorly done and the crate dirty the buyer concludes (generally correctly) that all of the work has been slighted and the crate therefore sells for a low figure. The external appearance of a package is worth 50% when it comes to the sale of that package. This does not mean, however, that one can afford to neglect the interior of the package. If the interior does not fulfill the promise that the exterior makes the package falls into bad repute on the market and is discounted thereafter.

Heads should be trimmed only enough to make them look well. since the outer leaves are a protection to a head. There is more or less loss of leaves in subsequent handling and the retailer likes to have some leaves he can trim off to improve the looks of the head. Pack the crate solid. There should be a bulge of an inch and one-half on the crates to hold them tight. This prevents bruising far more than it bruises. The square pack is satisfactory because lettuce shapes itself to fit its space. In the two layer crates used in Arizona anywhere from 12 to 24 heads are placed in a layer making 24 to 48 heads to a crate. It is not usually desirable to pack lettuce larger than 24 to a crate, and the 48 to the crate size is generally the smallest that is profitable.

Either precooling or ice in each crate is advisable especially in warm weather.

The only means at hand for precooling lettuce in Arizona is the storage room in ice plants not in use in the winter season. The disadvantage of using this space is the double handling necessary, but results are satisfactory when storage room is ample. It takes about 48 hours to reduce the temperature inside the crate to 36°F. when the temperature of the storage room is between 32° and 34°F. Lettuce will keep in cold storage long enough to gather a car early in the season.

When ice is used it is cracked into lumps a little smaller than one's fist so that it will last and yet not interfere with packing. Hard ice is best. Ice left in the sun becomes honeycombed and does not last well.

When a car is loaded there should not be play enough for a crate to move. There should be several inches between each stack of crates crosswise of the car, but lengthwise the stacks should be solid against each other. The space crosswise is for ventilation. There is room for 5 stacks of crates across the car but do not put that many in. Ventilating space is needed so that the cold air can circulate. Eighteen inches space at the top of the car is also very necessary since this is the warmest part of the car. Placing 7 crates in a stack and four stacks across the car permits 448 crates to go in. Unless ice is used in the crates the minimum weight of 20,000 lbs. cannot be put in a car.

ESTIMATED COST PER ACRE.

Cost of growing and shipping.	Low.	High.
Cr. mos. rent on land.....	\$ 6.00	\$ 15.00
Fertilizer	5.00	10.00
Breaking	2.50	4.00
Disking	1.00	1.50
Leveling	1.00	4.00
Furrowing50	1.50
Seed	1.00	3.00
Seeding	1.50	3.00
5 Cultivations @ 50 to 75c.....	2.50	3.75
5 Irrigations @ 25 to 40c.....	1.25	2.00
Water for Irrigation @ 75c per A. ft.	.75	1.25
Thinning	7.50	15.00
300 Crates @ 15c.....	45.00	45.00
Cutting 300 crates.....	10.00	12.00
Trimming and packing 300 crates....	10.00	15.00
3 Tons Ice @ \$6 or \$7.....	18.00	21.00
Hauling	3.00	6.00
Totals	\$116.50	\$163.00
Value of 300 crates @ 75c.....		\$225.00
Profit	\$108.50	\$62.00

These estimates should be taken with reserve since prices of labor and material differ so much, and the skill of the farmer has a great deal to do with costs. The above estimates are calculated on the basis of \$5 per day for man and team, \$3.75 per day for man and one horse, and \$2.50 per day for a man. Unusual efficiency can cut the costs given. The yield is conservative and should exceed 300 crates per acre if the maximum effort is spent. Liberal expenditures for fertilizers and for the care of the crop will undoubtedly prove to be profitable.

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