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Summary

VARIETIES used in commercial plantings have changed tremendously during the past 10-year period. Great Lakes varieties have largely replaced the Imperial varieties.

PLANTING DATES are now 2 weeks earlier in the fall and at least 3 weeks later in the spring. Early fall plantings start by August 15 and late spring plantings continue well into February.

PLANTING RATES are controlled largely by temperatures at seeding time. Use 2½ to 3½ pounds per acre for early fall planting. For late fall planting 1½ to 2½ pounds per acre should be ample. Reduce rates for winter planting to 1 to 2 pounds per acre.

SOIL, its location and management, greatly influence earliness, quality, and yield. The heavier cooler soils should be used for early fall crops when temperatures are high. Lighter, sandy loam soils located in warm areas are best used for late fall and early spring crops exposed to cooler temperatures.

IRRIGATION practice varies considerably with season, locality, and soil. Use preplanting irrigation whenever possible. For germination moisten beds thoroughly, but do not run water so long that soil becomes water-logged. Beds should be kept moist—not wet—during germination and seedling emergence. Keep irrigation to a minimum during cold weather.

FERTILIZING lettuce is best done with both inorganic commercial fertilizers and animal manures. Green manure crops may be substituted, in part, for animal manure. Nitrogen requirements without animal manures range from 60 to 120 pounds per acre. Phosphorous deficient soils should receive 45 to 60 pounds of P₂O₅, applied preplanting or as early side dressing.

HARVESTING should be done when heads are mature and firm. Immature heads are soft while overmature heads are too hard, subject to rib cracking and are otherwise of poor quality.

INSECTS, especially cabbage loopers and aphids, are very destructive. Properly applied and correctly timed applications of recommended insecticides are often necessary for their control. Other insects are usually of minor importance.

DISEASES may seriously affect yield and quality. Yellowing is prevented by improving soil structure and irrigating judiciously. Tip burn is best prevented by using resistant varieties. Rib discoloration cannot yet be controlled. Drop (Sclerotiniose) is reduced by applying calcium cyanamide to the soil. The spread of downy mildew is sometimes prevented by applications of zineb. Mosaic may be limited by the use of disease-free seed. Big vein is avoided by not planting on land with a history of the disease.
GROWING HEAD LETTUCE IN ARIZONA

W. D. Pew, R. B. Marlatt, and L. Hopkins

The acreage devoted to the growing of head lettuce, Lactuca sativa var. capitata in Arizona exceeds that of any other vegetable crop. Commercial vegetable growing in the state started with head lettuce production prior to 1910 while Arizona was still a territory. Since that time growing techniques, varieties, management practices, harvesting and marketing have changed tremendously.

The two major commercial production areas in the state are the Salt River Valley and the Yuma Valley. Production periods in these two areas vary somewhat because of differences in temperatures. Because of this, the entire production in the Yuma area is considered as fall lettuce although actual production extends from late fall through the winter and ends in early spring. On the other hand production in the Salt River Valley is restricted quite sharply into two growing periods. These are: fall and spring. Virtually no lettuce is harvested during the winter in the Salt River Valley.

During the past ten years, there has been a wide fluctuation in acreage in Arizona ranging from about 33,000 acres in 1954-55 to about 46,000 acres in 1950-51. During the past ten years yields have increased consistently. In 1944-45, the average yield was approximately 160 crates (332 cartons) per acre. In 1954-55, the average had increased to 217 crates (414 cartons) per acre. These increases have resulted in large part from improved fertilization and irrigation practices, heavier yielding varieties, more careful selection of soils for production and better insect and disease control.

Until recently, the Imperial iceberg-type varieties with their creamy-white inner portions and typical nutty flavor were most widely grown. The current market demands for greener colored lettuce and the extended growing seasons have caused a sharp reduction in the acreage of the Imperial types in favor of the Great Lakes varieties which are deeper green throughout and larger, somewhat heat and bolt-resistant. Associated with the varietal change has come a lengthened growing season. Only a few years ago first plantings were made during early September. Today the early plantings are made in mid-August. Late spring planting extends well into February, whereas it formerly ended in early January.

High quality lettuce can be produced only where the air and soil temperatures are moderately cool and uniform while the crop is maturing. Fluctuating temperatures do not promote good growth. High temperatures tend to cause seed stalk formation, loose heads, bitterness, and some diseases. Early in its development lettuce will tolerate considerable frost but, if severely frosted when mature, or nearly so, it is more subject to slime and therefore does not ship well.

---1---
SOIL TYPE

In Arizona lettuce is grown on many types of soil but the range from clay loams to sandy loams seems to be most desirable. For the early fall crop, which is subjected to relatively high temperatures, the clay loams or heavier types should be used. These soils have a greater water holding capacity and are usually cooler. For early spring lettuce lighter sandy loams that are well-drained and located in the warmer areas are preferred. Within limits the selection of a location is of greater importance than the soil type involved.

Regardless of the soil type selected one should consider the prevailing temperature of the area in which the soil is located when deciding when and where to plant.

VARIETIES

Lately there have been rapid changes in the development of head lettuce varieties to meet-current demands. Therefore, only a few of the recently most popular varieties will be described in this bulletin.

Further, since there are many Great Lakes varieties available which differ in one or two characteristics such as size, maturity, shape, and head exposure, only the general characteristics of the Great Lakes type will be given. For specific variety recommendations, consult your local County Agricultural Agent.

Great Lakes

Plants of Great Lakes varieties are very large, vigorous in growth, and dark green. This deep color carries well into the heads as compared with many of the other commercial varieties. The heads are usually very symmetrical, large, firm, well folded, and in many cases often exposed when mature. Although the leaves of the heads are well folded, they are easily separated one from another because they are relatively smooth. The leaves are usually of crisp, brittle texture although they are sometimes tough. These varieties are excellent shippers but do not have the eating quality of the Imperial varieties. Great Lakes varieties are heat tolerant and resist “bolting” (premature seeding).

Because of their heat and “bolt-
ing” resistance the Great Lakes varieties are planted primarily for the early fall and late spring crop. Nevertheless these varieties are sometimes used throughout the entire growing season.

**Imperial 44**

Imperial 44 is one of the old standard varieties but is being replaced to some extent by Great Lakes varieties. Plants of this variety are somewhat smaller than those of the Great Lakes varieties but do grow vigorously. The external color is medium-green. This color tends to become more pale as the plants reach maturity. The heads are medium to large with a medium-green outer color that gradually changes to a pale, creamy color toward the inside of the head. The leaves forming the head are usually well folded. On occasion there is a tendency for the leaves to spiral, causing a peaked head. Leaves forming the head are typically crinkled and interlock making them difficult to separate without tearing. This variety is an excellent shipper and has the excellent eating quality of most Imperial varieties. It is not particularly resistant to “bolting” and is only slightly heat resistant. It is normally planted for the late fall crop.

**Imperial 615**

The Imperial 615 variety has long been an important winter and early spring variety. Plants are rather large and vigorous. The external color is medium-green which tends to fade as the heads mature. The heads are large, firm, usually well formed, and well folded. They have a medium-green external color that gradually changes to a pale, creamy color toward the inside of the head. Leaves are typically crinkled and interlock, making them difficult to separate without tearing.

Imperial 615 is a good shipper and has the excellent eating quality of most Imperial varieties. It is not heat tolerant or resistant to “bolting”. It is quite cold tolerant and consequently is planted in the late fall for winter growth and early spring harvest.

**Imperial 101**

Plants of the Imperial 101 variety are very similar to those of Imperial 615 but are slightly darker green, tend to be a little larger, and have a somewhat coarser appearance.
PLANTING DATES

Changes in varieties have been so rapid in the past few years that planting dates have been pushed two weeks earlier in the fall and at least three weeks later in the spring than were common a few years ago. The following planting schedules have been generally established and will prove valuable as a guide. These dates are very general and must be considered as such. Certainly no set of dates will suffice for each locality or grower.

Generally accepted planting dates:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Date Planted</th>
<th>Salt River Valley Area</th>
<th>Yuma Valley Area</th>
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<tr>
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<td>Aug. 27 to Sept. 15</td>
<td>Great Lakes</td>
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<tr>
<td>Imperial 44</td>
<td>Aug. 27 to Sept. 15</td>
<td>Aug. 27 to Sept. 15</td>
<td>Aug. 27 to Sept. 15</td>
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<tr>
<td>Imperial 101</td>
<td>Oct. 15 to Nov. 15</td>
<td>Oct. 15 to Nov. 15</td>
<td>Imperial 44</td>
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<tr>
<td>Imperial 615</td>
<td>Nov. 1 to Nov. 25</td>
<td>Nov. 1 to Nov. 25</td>
<td>Imperial 101</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>Nov. 15 to Feb. 15</td>
<td>Nov. 15 to Jan. 15</td>
<td>Imperial 749</td>
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<tr>
<td>Great Lakes</td>
<td>Aug. 15 to Sept. 10</td>
<td>Aug. 27 to Sept. 15</td>
<td>Great Lakes</td>
</tr>
<tr>
<td>Imperial 44</td>
<td>Aug. 27 to Sept. 15</td>
<td>Aug. 27 to Sept. 15</td>
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<tr>
<td>Imperial 101</td>
<td>Oct. 15 to Nov. 15</td>
<td>Oct. 15 to Nov. 15</td>
<td>Imperial 44</td>
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<tr>
<td>Imperial 749</td>
<td>Oct. 20 to Nov. 1</td>
<td>Oct. 20 to Nov. 1</td>
<td>Imperial 101</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>Nov. 15 to Jan. 15</td>
<td>Nov. 15 to Jan. 15</td>
<td>Imperial 749</td>
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1There are many Great Lakes varieties currently on the market. Each of these differ in varying degrees from the older Regular Great Lakes variety.

PLANTING RATES

Since head lettuce is very sensitive to high temperatures during the germination period this factor should be carefully considered in determining rates of seeding. If the soil temperature is higher than 80°F for many hours per day, the germination percentage will be greatly reduced. Consequently early fall plantings, when the soil temperature is usually high for extended periods, will require a larger quantity of seed to get an adequate stand than plantings during cooler periods.

For early fall planting the seeding rate will vary from 2 1/2 to 3 1/2 pounds per acre. In the late fall when the soil temperatures are lower, the rate may be reduced to 1 1/2 to 2 1/2 pounds per acre. For the winter and early spring plantings, the rate is further reduced to 1 to 2 pounds per acre.

PLANTING AND SEEDBED PREPARATION

In preparing the seedbed for planting head lettuce, the soil should be thoroughly, but not excessively tilled so that it is soft and friable, of crumb structure, receptive to water, and free from hardpan layers. The soil should be plowed or otherwise broken to a depth of 10 to 12 inches. This is the first and perhaps the most important step in bringing about the previously mentioned soil conditions. However, many of the advantages normally derived from proper plowing or similar soil-breaking practices can be and are often destroyed by improper or excessive numbers of subsequent tillage operations. These may create conditions that reduce water penetration and limit air passage into the soil. If a hard-pan exists in the upper two feet of soil, it should be eliminated by proper deep plowing, knifing, or similar soil-breaking procedures.

In preparing the soil for lettuce production, each tillage operation should bring about one or more beneficial effects. Generally all tillage operations should have one or both of the following aims: (1) to provide conditions for optimum moisture penetration and air movement, (2) To eliminate surface un-
evenness in the field.

After the field has been plowed or otherwise broken, it should be bordered and a preplanting flood irrigation applied. This irrigation not only supplies the sub-surface with moisture but also brings about weed seed germination. These weed seedlings can easily be destroyed by a subsequent diskling while preparing the land for furrowing-out or listing. The corrugation method for applying the preplanting irrigation is sometimes used, but is not recommended because salt may accumulate on the ridges rather than being leached to lower soil strata.

Following the preplanting irrigation, after weeds have emerged and the field is dry enough to work, the borders are removed and the area given one and not more than two deep diskings to dry and aerate the upper 6 to 8 inches of soil. After the soil has had time to aerate and cure for a few days to a week or more, a light float or drag is drawn across the field at an angle different from that to be used in planting. Floating or dragging to smooth and firm the soil surface makes it easier to list or furrow-out. Furrowing-out is done with a regular cotton type lister equipped with 3, 14-inch bottoms. The depth of the furrow is usually 6 to 9 inches depending on final bed height desired. The use of a land-plane is not recommended for this operation. The land-plane is best used prior to plowing or soil breaking. Following the use of the land-plane, care should be exercised so that the level of the land is not altered by any subsequent land preparation operation.

Bed spacing depends largely upon the equipment to be used in planting. Generally the beds will be either 40 or 42 inches apart from center to center. Of these spacings, the 40-inch one is the most widely used.

In spite of the precision necessary in preparing a lettuce seed bed, no
more tillage operations should be made than are absolutely necessary.

Planting should be done in dry soil. The number of seed rows or beds planted simultaneously will depend on the type of equipment available for planting and cultivating the crop. Generally speaking, 6 seed rows or 3 beds are planted at one time with a sled. The planting arrangement usually is such that 2 full beds and 2 half-beds, one to either side of the full beds, are seeded at once. These outside rows are called “guess rows”. The second side of these “guess rows” is planted as the planter is drawn down the next set of beds. This method is used because it best fits the furrowing and cultivating equipment and helps compensate for a certain amount of irregularity in bed spacings between adjacent sets of listed beds.

The height of beds is an important consideration from a temperature and moisture standpoint. Higher (6 to 8 inch) beds tend to warm faster than shallow ones, but require more water to moisten them properly. Conversely, lower beds warm slower but take much less water to produce the desired wetting. Because of temperature differences the higher beds are used for winter and spring plantings while the lower beds are used for fall plantings.

The rows should extend north and south to minimize temperature differences on the bed sides. This is very important during the winter and spring plantings. If rows run east and west during the cooler months, plants on the south side will grow very rapidly while those on the north side will grow slowly. In many cases the north exposure plants fail to attain the necessary size for shipping. If these heads do develop sufficient size, they mature much later than those grown on the south exposure. This creates serious harvesting as well as cultural problems.

The ideal seed depth in planting is between 1/8 and 3/8 of an inch. The seed is sufficiently deep, using commercial planting methods, when about 10% of the seed is visible in the seed row after planting. Packer wheels normally found on seeder units are not used in planting lettuce. They should be removed and the planters mounted semi-firmly onto the sled so that the planter shoes maintain a constant depth in relation to the sledded beds. The use of the packer wheel will cause the seed to be planted too deeply.

SPACING AND THINNING

Lettuce should be thinned after the first two true leaves have developed and before the plants begin to crowd. For the fall-seeded crop when the weather is warm and plant growth is rapid, the time will be from 3 to 4 weeks following the germination irrigation. During the cooler periods, as long as 8 weeks
Figure 6.—Hand thinning of lettuce. Notice special short handled hoes used in this operation.

will be necessary to develop plants with enough size for thinning.

Individual plants are thinned to 12 to 16 inches apart in the row. Each plant should be given ample space in which to grow and develop. Plants that are too close will produce small heads and will usually be delayed in maturity. Spacing of individual plants in the seed row, as well as the width between the two rows on each bed, is influenced chiefly by variety, although season is also important. The larger varieties are usually spaced farther apart than the smaller growing ones. In the thinning operation the plants are blocked-out at the specified distance in the row with special short-handled hoes. Following blocking the spaced clusters of plants are thinned by hand so that only one plant remains in each place. Blocking lettuce fields by machine with subsequent hand-thinning of the remaining clumps of plants to a single plant-per-place stand is sometimes practiced. A very uniform seedling stand is required for machine blocking. The chief advantages of mechanical blocking are uniformity of plant spacing within the row and ease and speed in the final hand-thinning.

During the hand-thinning operation there are occasional places where two or more seedlings are left growing. If too many doubles occur, hand laborers are used to remove the extra plants. This is called "doubling." Where two or more seedlings are allowed to grow in one place, the heads that develop usually are flat-sided or otherwise poorly formed and often unmarketable.

From planting to thinning time the beds and furrows are usually cultivated one or more times primarily to control weeds. To firm and smooth the surfaces of the beds and to pulverize the clods brought up in cultivation, a large roller weighing 1000 pounds or more is pulled parallel with the beds. Usually three beds are rolled at one time. This makes hand-blocking and thinning easier and more rapid.

Thinners should be instructed to cut all weeds in the seed row that were missed during earlier cultivations. Persons thinning the crop should be instructed to disturb as little soil as possible. Following thinning the plants may be side-dressed with fertilizer and the field re-furrowed. In any event, the field should be re-furrowed and the soil replaced against the thinned plants. This practice also opens the furrow so that an irrigation can be applied to moisten and firm the soil around
the plants and to carry an applied fertilizer to the roots. This helps them recover faster from the thinning operation.

**IRRIGATION**

In Arizona, lettuce production is dependent upon supplemental water from storage reservoirs or deep wells.

The pre-planting irrigation practice varies considerably with season, locality, and soil. This practice is most important and is more widely used for the fall crop than the spring plantings. Nevertheless where time will permit and where weeds or salts are a problem, a pre-planting irrigation would be beneficial for the spring crop. The flat or border-type irrigation is preferred for the pre-planting application.

A pre-planting irrigation is important for at least three reasons: (1) To supply the subsurface soil with ample moisture for use by the plant during the heading and maturing period. (2) To germinate and sprout weed seeds that can be destroyed during subsequent disking operations before the crop is seeded. (3) To leach the soluble salts below the seed zone to facilitate germination.

The furrow method is most commonly used for irrigating lettuce beds. In furrow irrigation the water should be allowed to move into the soil or "sub" until the entire bed is moistened to the point desired.

In distributing water into each furrow from the head ditch, many growers use small flumes or conduits. These flumes may be short lengths of rubber tubing about 1½ inches inside diameter. Used coup-

![Figure 7.—Diagramatical sketch of beds and furrows of the type used in growing lettuce in Arizona and the position of irrigation conduits leading from head ditch into furrow.](image)

ling hoses from railroad cars, if available, make excellent flumes. Sections of metal pipe or tubing of the appropriate inside diameter, 18 to 21 inches long, may also serve effectively as conduits. Wooden tubes may be made by nailing together four laths or similar wooden material. These flumes save much time and spade labor in irrigating. They also make it easier to regulate the flow of water in each furrow.

To avoid upheaving and breaking the installed tubes during cultiva
tions they should be placed at an angle so the intake end (the end in the head ditch) is in front of the bed with the tube extending across the corner of the bed with the outlet end in the furrow. The bottom of the tube should be placed level with the floor of the furrow. Although the use of conduits is recommended, open-end furrows may be used.

The first irrigation following planting is normally referred to as the germination irrigation. The length of time water is allowed to run for this application will vary considerably with soil type, time of
Figure 8.—Effects of poor soil conditions and excessive soil moisture. Left: Plant showing lettuce yellowing (physiological) due to poor drainage and excessive soil moisture. Notice limited root system and pale, leathery appearing leaves. Right: A normal plant growing on well drained soil and optimum soil moisture.

day application is made, length of run, land slope, height of beds, and season. However, it should run long enough so that the beds are “blacked”, or entirely moistened. Where short, ½-mile rows are used on the more ideal soil types an 18 to 24 hour irrigation should be long enough to get the desired results. The next irrigation, for the fall crop, will usually follow in about 2 days since hot, drying conditions usually prevail at this time of year. The interval between these irrigations for spring lettuce will range from 5 to 10 days depending on climatic conditions. However, regardless of season involved the surface soil should be kept moist until the seedlings are through the ground.

Running water continuously for several days, even after the beds are thoroughly soaked, is not recommended. This practice will often water-log the soil, reduce the soil air to the critical point, and retard germination. In an over-watered soil the stand will be spotty. Often there are so many skips and seedling emergence is so irregular that the entire field must be replanted.

After a stand is established water is usually withheld until just before thinning. A cultivation may be necessary during this period to destroy any weeds that have begun to grow and to mulch and seal the cracks in the drying soil. If the
plants indicate a need for water during this period it should be given.

A third application is usually made to soften the soil as an aid in thinning. If the soil conditions are such that thinning can be done without irrigating, the next application of water should be made shortly after the plants have been thinned. Whether or not an irrigation is made just before thinning, the field should be irrigated shortly after thinning. The reasons for this irrigation were discussed under the section on spacing and thinning. The timing of all following irrigations should be determined by the condition of the crop and not by any prearranged schedule of days.

Under no circumstances should excessive waterings, either in numbers or duration, be used. This is particularly true during cold weather. Not only do they waste water but, even more important, they make for poorer plant growth. Nevertheless, once the plants are in the rapid growing or forcing period after thinning, they should not be allowed to suffer for water. Irrigation periods will usually be from 10-day to 2-week intervals during the early growth period for the fall crop. These intervals should be shortened to 7- to 10-day periods during the time the heads are developing. In the spring crop, these intervals may extend for as long as 4 weeks or more during early growth and 7 days to 10 days when the heads are forming.

As one gains experience, determining when to irrigate will become easier. In applying water the stream in each furrow should be only large enough to get the water through the row. Too large a stream will often cause flooding over the tops of the beds. If this flooding occurs the soil will bake, crust, and finally crack as it dries. Under these conditions, the seedlings usually fail to emerge. If emergence does occur where the beds have been flooded, the seedlings are usually weak. These weakened plants will remain unthrifty throughout their life.

An irrigation should be made between cuttings to assist in further growth and development of the unharvested heads.

**FERTILIZATION**

Relatively high soil fertility levels must be maintained for good lettuce production. The most widely used method is through the use of commercial synthetic fertilizers. A second method is through the use of animal manures. A combination of the two methods is the preferred way to keep productivity high and at the same time to help maintain a good soil condition. Where animal manures are not available or where the cost is prohibitive, a green manure crop should be used to help take the place of the animal manures. Properly grown green-manure crops can furnish an abundance of organic matter. In addition, the flat or flood-type irrigation method used for growing these crops helps to keep the soluble salts leached to the lower soil strata. Green manure crops, even legumes like alfalfa, sesbania, and papago peas, are not sufficient to meet the nutrient requirements for lettuce production. In turning under any green-manure crop, it is suggested that from 50 to 75 pounds of actual nitrogen be applied to the residue at turning-under time to aid in the
decomposition process. The exact amount of nitrogen will depend chiefly on age, volume, and type of crop being turned under.

In securing animal manures, every effort should be taken to get well-rotted, high quality, feed lot material. It should also be relatively free from viable weed seeds. The manure should be applied uniformly at the rate of 10 to 15 tons per acre and immediately disked in. Experiments have shown that fields treated with manure produced better quality lettuce, better yields, and crops that matured 2 to 3 weeks earlier. On most soils where manure is used, applications of nitrogen should be made at a rate of 30 to 60 pounds per acre. It should be applied after thinning and/or when the heads are forming and sizing.

On phosphorous deficient soils about 45 to 60 pounds of P\(_2\)O\(_5\) should be used. This fertilizer must be applied at pre-planting time or as an early side dressing to get maximum benefit from its use.

Commercial fertilizers are generally necessary to keep the soil highly productive even where organic matter has been supplied through green manure crops or animal manures. Nitrogen is the fertilizer element most often needed for lettuce crops grown in Arizona. It is usually the limiting factor in lettuce growth. The kind or source of nitrogen, according to experimental evidence, makes little difference on plant growth and yield as long as each is applied correctly and at the same rate of actual nitrogen per acre. However, the use of sodium nitrate should be avoided because of the added sodium. The presence of sodium is the cause of many of our soil structure and salt accumulation difficulties.

Where commercial synthetic fertilizers are used as the only source of nitrogen, the amount of nitrogen needed will range from 60 to 120 pounds per acre depending chiefly on the soil type, previous cropping history, and residual fertilizer.

Many methods of application are practiced under commercial conditions. A practice that has given excellent results is to apply about \(\frac{1}{2}\) to \(\frac{3}{4}\) the amount of nitrogen expected to be used to grow the crop as a pre-planting application. The remaining \(\frac{1}{2}\) to \(\frac{3}{4}\) is applied as one or more side dressings after thinning and during head formation and development. The pre-planting application may be broadcast, injected or applied in the irrigation water. The listing operation in preparation for seeding folds the fertilizer out of the furrows into the beds for maximum utilization.

The second fertilizer application is made following thinning and before the subsequent irrigation. If more nitrogen is needed, as indicated by the appearance of the crop, another application can be made as the heads begin to form. Certainly the final criterion in determining the amount and frequency of fertilizer applications is plant appearance. Although specific times of application have been suggested, it is possible to effectively apply inorganic nitrogen fertilizers from the time the plants are thinned until 3 or 4 weeks before harvest.

The position of fertilizer placement is important. Pre-planting injections of fertilizer should not be deeper than 6 to 8 inches. The position for the side-dressed dry-
type fertilizer, after the plants are established and thinned, is from 1½ to 2 inches to the furrow side and 1½ to 2 inches below the seed level. Do not place side-dressed fertilizers too deep because they may be leached by irrigation downward out of the root zone. Injection of side-dressings should be 8 to 10 inches from the lettuce row and deep enough to get a good sealing action following the shank opening. The application of side-dressed nitrogen in the irrigation water is another effective and efficient method.

For soils that respond to phosphate fertilization an application should be made early in the growing season. Best results are obtained where phosphates are applied in a pre-planting application or as a side-dressing immediately after thinning. Never use phosphate as the only fertilizer.

The use of potash is not recommended because most soils adapted to lettuce growing have more than enough to meet the requirements of the crop. Experiments have shown no increase in yield or measurable differences in quality through the use of applied potash fertilizer.

A cultivation should do one or more of the following:
1. Control weeds.
2. Replace the soil around young plants after thinning.
3. Open the furrow for irrigation.
4. Mulch the furrow area to facilitate proper side dressing of fertilizer.
5. Loosen the surface soil to aid in water penetration and "subbing" and to improve aeration.

YIELD

Yields calculated on the basis of actual shipped produce will depend largely on demand and supply. This factor has greatly influenced the figures recorded as average yields from year to year. Beyond this, yield will vary materially from year to year due to weather, insects, and diseases. If demand and supply are not considered in calculating yields, average production would be approximately 400 to 450 cartons or 200 to 225

CULTIVATION

Cultivate only when there is a good reason for doing so. If weeds are abundant, one or two cultivations may be necessary before thinning. After thinning, cultivations may be needed to control weeds that compete with the lettuce plants for nutrients and water. Cultivation is also needed to replace soils around the young developing plants and to open the furrow for irrigation.

Figure 9.—Cutting and trimming for packing in the field. Notice the type of knife used.
Lettuce. being packed on packing and loading machine. Notice empty cartons being loaded from rear of truck onto conveyor belt. Packed and sealed cartons are placed on lower conveyor belt and moved to truck where they are loaded to front of the truck. Observe also the cutting and trimming crew working ahead of machine.

Figure 10.—Lettuce being packed on packing and loading machine. Notice empty cartons being loaded from rear of truck onto conveyor belt. Packed and sealed cartons are placed on lower conveyor belt and moved to truck where they are loaded to front of the truck. Observe also the cutting and trimming crew working ahead of machine.

... Continued...

Harvesting is done by hand, using specially designed cutting knives. Plants that are slightly wilted are in the best condition for cutting and packing. Plants that are very crisp and brittle break easily in handling. Heads that are damaged are less attractive and are also more susceptible to spoilage. A crew of men go down the furrows selecting and cutting matured, marketable heads from the two plant rows adjacent to the furrow. These heads are then trimmed and laid bottom-side-up in the plant row from which they are cut. In trimming, care should be taken to remove damaged and diseased leaves or leaf tips. Packing crews follow either on foot or on a packing and loading machine, packing the lettuce in cartons.

Depending on the size of heads, each carton will contain either 18, 24, or 30 heads. The growers and shippers currently prefer the 2-dozen (24-heads-per-carton) size. Cartons vary in size slightly but the standardized size is now 9¾" x 14" x 21". In carton packaging, the lettuce is placed in two layers. The bottom layer is inserted into the carton with the bottoms down and the top layer with the bottoms up. This arrangement minimizes damage to the heads. When the carton is completely filled, a heavy paper pad is placed over the upper layer and the top of the carton closed and stapled shut. Some pads are chemically treated to prevent the cut stems from becoming discolored. After the cartons are stapled, they are loaded on large flat-bed trucks and transported to cooling plants. To minimize bed and crop damage in the field during loading these trucks are specially designed...
with wide axles. They can span two beds and thus can be driven down the furrows in the field without damaging uncut heads.

Most of the cartons are taken to vacuum-type cooling units where they are quickly cooled to about 35°F. They are removed from the cooling unit and loaded into pre-cooled refrigerator cars and trucks. After the bunkers of the loaded cars are iced, they are ready to move to market. In some cases the lettuce is not pre-chilled but is
shipped in pre-cooled cars equipped with fans that circulate cold air from ice in the bunkers. Lettuce for the local market is generally not cooled.

The older method of using wooden crates is still practiced to a limited extent. The number of heads per crate will be 3 or 4 dozen. The 4-dozen size is presently preferred by growers and shippers. In packing, the lettuce crate is lined with two strips of heavy waterproofed paper that covers the bottom, sides, and ends of the crate and folds over the top when filled and ready for lidding. Three layers of heads are packed in the crate with the butts or stem-ends up. Crushed ice is placed between the layers. After the crates are loaded into the refrigerator car, crushed ice is blown into the car and over the load with some of the ice sifting down through the spaces between stacked crates. The bunkers at the ends of the cars are also usually filled. When this is completed, the cars are ready for shipment.

INSECTS

CABBAGE LOOPER *Trichoplusia ni* (Hubner)

The cabbage looper is the most important insect pest of lettuce in Arizona. Loopers appear as soon as the cotyledon leaves of the lettuce are above ground and will persist until harvest. The presence of loopers is first indicated by the white eggs laid singly or in loose groups, usually on the underside of the leaf. The eggs are flat-cone shaped and hatch in 2 to 5 days. The young loopers are pale-green with a black head. These young larvae feed on the underside of the leaf, without showing any damage on the top surface. At the first molt the head becomes light tan or pale-green and remains this color during the remainder of the larval stage. Later, the entire leaf tissue is eaten and the presence of the loopers becomes noticeable. During this period of growth, each larva may consume its own weight in food every 24 hours. This is the stage of growth when the greatest amount of damage occurs.

Full grown larvae are 1 1/4 to 1 1/2 inches long, green in color and with or without white “V” lines along the sides of the body. Since there are only two pairs of abdominal legs, rather than four, on the larvae, the middle of the body is not supported and consequently must be looped during movement. It was from this characteristic looping movement that this insect was named.

The mature larvae spin a loose silken cocoon in which they pupate on the plant. The pupal stage lasts 6 to 14 days. It is pale green at first but later turns dark brown. The grey mottled moth that emerges
is readily identified by the silvery white mark on each forewing.

Although the cabbage looper is attacked by insect predators and parasites, they seldom keep it under control and chemical applications are usually necessary to protect the crop. The recommended insecticide dusts for the control of loopers is 15% toxaphene-5% DDT, or 20% toxaphene applied at 15 to 30 pounds per acre. Cryolite dust is also used in some cases but is inferior to other insecticides.

The accepted residue tolerance for toxaphene, DDT or cryolite (fluorine) on lettuce is seven ppm (parts per million). In order to meet this tolerance, none of these materials should be applied within 30 days of harvest.

**BEET ARMYWORM** *Laphygma exigua* Hubner and the **Yellow Striped Armyworm** *Prodenia orni-thogalli* Guen.

While lettuce is in the seedling stage the beet armyworm and the yellow striped armyworm may become serious pests. These armyworms will consume the entire plant and if present in sufficient numbers will reduce the stand. The armyworms are seldom pests late in the growing season since looper control applications of insecticides control them very readily.

The eggs of the beet armyworm and the yellow striped armyworm are extremely difficult to distinguish from each other. They are both laid in masses of 20 to 60, are small, pale green in color and covered with a mass of greyish scales from the body of the moth. This protects the eggs from the heat as well as from parasites. The larvae are green with black heads. They may be distinguished from young loopers by the presence of four pairs of abdominal legs rather than two as found in the looper. The early instars of the yellow striped armyworm may be identified by the pinkish color of the front and rear end of the abdomen.

The beet armyworm is greyish green in color with a dark stripe along each side. After the second instar there is an irregular shaped black spot on the thorax above the second pair of legs. When mature they are 1 to 1 1/4 inches long. The moth is small, mottled greyish in color and is seldom seen except late in the evening.

The yellow striped armyworm measures 1 1/2 to 1 3/4 inches when full grown and is quite variable in coloration, some being much lighter than others. In general this armyworm is purplish brown in color with broad yellow stripes on each side. The back of the worm is usually velvety black. The moth is larger than the beet armyworm moth and is mottled with reddish-brown, white, grey and black.

The life cycles, habits and controls of these two armyworms are very similar. The eggs are usually placed on the plants, although occasionally they are laid on the ground and hatch in 5 to 10 days. The young larvae are scattered by the wind, when they spin silk threads in moving around. It requires the larvae about 15 to 22 days to complete their growth. The mature larvae burrow into the soil an inch or two, hollow out a space and pupate. They usually remain in the pupal stage for 10 to 15 days, but may also overwinter in this stage.
The yellow striped armyworm prefers to feed on weeds rather than lettuce but frequently it will move into a field from weedy ditch banks and destroy lettuce around the edges of the field. The recommended insecticides for the control of these armyworms, are 10% DDT, 15% toxaphene-5% DDT or 20% toxaphene. These materials should be applied at 15 to 30 pounds per acre, depending on the size of the plants and type of equipment used. Comparable amounts of sprays are also effective in controlling these worms.

GREEN PEACH APHID *Myzus persicae* (Sulzer) and LETTUCE APHID *Macrosiphum barri* Essig

Aphids are a problem on lettuce only during the spring growing season and may become so serious that at times the crop is destroyed. Aphids are important in two ways. Their presence and their sticky honeydew are objectionable on the head. Their ability to transmit mosaic is also important in the Yuma area.

Of the two species of aphids found on lettuce the green peach aphid is the most important. The green peach aphid is smaller than the lettuce aphid. Its color varies from green to yellowish and pinkish. The winged aphids are marked with black on the thorax and have a distinct black patch on the abdomen. The green peach aphid has a very wide host range and is commonly found on most cultivated crops. The lettuce aphid is somewhat larger than the green peach aphid and is uniform green in color. In many specimens faint whitish lines may be seen on the abdomen of the wingless individuals. The lettuce aphid is found only on plants that belong to the lettuce family.

Aphids start building up on weed hosts in the early spring, from which they migrate to fields of lettuce. Once in a field they increase rapidly until the plants are covered. Winged aphids move to other areas until the entire field is uniformly covered with the aphids. The rapid rate of reproduction is responsible for this heavy build-up.

Predators and parasites are usually effective in maintaining low aphid populations. However, under certain conditions, aphids multiply faster than the natural enemies are able to destroy them. Under these conditions insecticide applications are often necessary to eliminate aphids in lettuce as it starts head-
The recommended insecticide dusts are 5% malathion, 2% parathion or 4 to 6% nicotine. These materials should be applied at the rate of 15 to 20 pounds per acre by ground equipment or 20 to 30 pounds per acre if applied by aircraft. TEPP dust may be used, but the results often are unsatisfactory.

The accepted residue tolerance on lettuce for parathion is 1 ppm; for malathion, 8 ppm; and for nicotine, 2 ppm. In order to maintain residues on the marketable heads within these tolerances parathion should not be applied within 15 days before harvest, malathion should not be applied within 7 days of harvest and nicotine should not be applied within 5 days of harvest.

**CUTWORMS** *Agrotis spp.* and *Felisia spp.*

There are several species of cutworms that damage lettuce, principally when it is in the seedling stage. The main damage results when the seedlings are cut off at the ground line or when the leaves and cotyledons are destroyed, leaving only the main stem standing.

The eggs of the cutworms are laid in loose groups of 5 to 12 on the undersides of the leaves. They are relatively large, ribbed and show a purplish-brown band a few hours after being deposited. The eggs hatch in 3 to 6 days. The larvae remain under clods and debris during the day and feed during the night. The larvae are greyish brown in color, usually with a few darker markings. The color, however, may vary from greenish to nearly white. They measure 1½ to 1¾ inches in length. When mature, the larvae burrow into the soil 2 to 4 inches where they pupate. The pupal stage lasts from 7 to 18 days during the warmer months; however, the entire winter may be passed in this stage. The moths are large to medium in size with dark mottled forewings and almost pearly white hind wings. They are primarily night fliers and are seldom seen during the day unless disturbed.

If cutworms become numerous, the stand of lettuce may be reduced to the point where replanting may be necessary. When the cutworms begin damaging the seedlings, applications of insecticides may be necessary. The recommended treatments are commercial apple peel baits (containing sodium fluosilicate) 10% DDT dust, 20% toxaphene dust or 10% chlordane dust. The baits are applied at rates of 10 to 12 pounds per acre. The dust formulations should be applied at 12 to 15 pounds per acre with ground equipment.

**CORN EARWORM** *Heliothis armigera* (Hubner)

Occasionally during the spring lettuce season the corn earworm attacks lettuce. The damage is seldom noticed, however, until harvest.

The greyish-tan moth deposits her eggs singly on the lower leaves of the plant. The larvae, upon hatching, bore into the head where they are protected. The larvae spends its life cycle inside the head, feeding on the leaf tissue.

Once the earworm is inside the head it is impossible to control it, consequently it must be controlled before it enters. In order to do this, careful inspections of the field must be made beginning at the time the heads start forming. The presence
of eggs or small worms will indicate the necessity of applying an insecticide. Due to the existing residue problems, however, the proper timing of the applications is very important. The recommended insecticide for the control of the earworm is 10% DDT dust or 15% toxaphene-5% DDT dust applied at a rate of 20 to 30 pounds per acre.

The official tolerance for DDT and toxaphene on lettuce is 7 ppm. In view of this, neither of these chemicals should be applied closer than 30 days to harvest. Thorough applications made at this time should protect the lettuce from the earworm without leaving excessive residues on the marketable head.

**CRICKETS Acheta sp.**

Crickets occasionally cut off seedling lettuce plants. They hide along ditches or in cracks in the field during the day but emerge at night to do their feeding. Because of their night feeding habits, they often do considerable damage before they are discovered.

Crickets may be controlled by dusting with 15% toxaphene-5% DDT, 10% chlordane or with 2% dieldrin at a rate of 15 to 25 pounds per acre. Apple peel bait applied at 10 to 15 pounds per acre is also effective.

**LEAFMINERS Liriomyza sp.**

Leafminers are seldom a problem except when lettuce seedlings are growing slowly. At this time the miners attack the cotyledons and leaves with such severity that the plants may be killed. If the seedlings are vigorous and growing rapidly, leafminers are not a problem. However, if it becomes necessary to control this pest an application of 2% parathion dust applied at 15 to 25 pounds per acre should be used.

**SALT MARSH CATERPILLAR Estigmene acraea (Drury)**

Migrating masses of salt marsh caterpillars or “wooly worms” are often severe pests of lettuce. They build up in cotton fields, from which they migrate in the fall. Lettuce may be rapidly and completely destroyed by wooly worms if left unprotected.

It is practically impossible to control migrating wooly worms with insecticide applications. The best method of control is the use of aluminum foil barriers around the fields. The foil should be buried in the ground 3 to 4 inches, leaving 6 to 7 inches above ground. This prevents the “worms” from moving into the field. Deep holes should be dug at intervals along the outer side of the barrier to trap the wooly worms as they move along the foil. The trapped larvae should be killed and the holes cleaned out regularly. The foil should be inspected frequently for breaks or bridging over by masses of the larvae.

Other insects may become pests at times. When this happens, consult the local County Agricultural Agent for the best control methods.

**DISEASES**

**YELLOWING (Physiological)**

On plants affected by this disorder the older frame leaves lose their green color and gradually become yellow. Discolored leaves appear thickened and leathery to the touch (see Fig. 8). More leaves are gradually affected until those next to the head are also yellowed.
The disease is common in the early spring crop and is caused by a combination of slow growth during cold weather and excessively wet soil. Heavy irrigation on poorly drained soils prevents sufficient air from getting to the lettuce roots. This causes the leaves to turn yellow.

Cultural practices which overcome or prevent poor drainage and poor soil structure provide the best control for yellowing. Judicious use of water and fertilizer during a period when lettuce is growing slowly is also helpful.

**TIPBURN**

As lettuce approaches maturity, some of the larger leaves within the head occasionally have brown, dead margins. Marginal areas between the veins are the first to die; later the entire margin may be killed. If the disease is severe, most of the head leaves may be damaged. Frequently the leaves that are injured by tipburn will rot and the entire head may be ruined.

This tipburn condition is not a contagious disease but is probably caused by certain weather conditions.

Selection of tipburn resistant varieties is continually being made during the lettuce breeding that is being carried on at the present time. No other means for controlling the disease has been satisfactory.

**RIB DISCOLORATION**

Yellowish-brown spots, later becoming dark brown or black, may appear within the main ribs of lettuce leaves. This is referred to as rib discoloration or "rib blight." The cap leaf or a few leaves under it are most likely to be damaged. The disease first appears as heads approach maturity and is most commonly found in spring lettuce.

The cause and control of rib discoloration are not known.

**DROP OR SCLEROTINIOSE**

This disease has been called a variety of names, including watery-brown-rot and side rot. “Drop” is a very descriptive term because diseased plants collapse or fall on one side. The leaves wilt, turn greenish-yellow then brown, and the outer leaves flatten against the ground. Later the entire head collapses. If a plant is infected, it breaks off easily at the surface of the soil.

Drop is caused by a fungus that is easily identified by its fluffy, white appearance and by the hard, black resting bodies that are formed on the decayed plant. The black pieces of fungus can remain in soil for years and can start infections in the next lettuce crop.

The disease can be satisfactorily controlled in fall lettuce by applying calcium cyanamide to the soil before irrigating and disk ing prior to bedding. The chemical can be disked into moist soil before bedding for the spring crop. Eight hundred to one thousand pounds of calcium cyanamide per acre is recommended for heavily infested soil. AFTER THE CHEMICAL IS APPLIED, PLANTING SHOULD BE DELAYED 3 DAYS PER 100 LBS. OF CALCIUM CYANAMIDE APPLIED.

In years following this heavy application some growers have had satisfactory results by applying 300-500 pounds per acre of calcium cyanamide each season.
Crop rotation, in addition to calcium cyanamide application, has been helpful if production of cool season vegetables is avoided.

DOWNY MILDEW
Winter and spring lettuce is sometimes infected by the downy mildew fungus. Light green spots are formed, usually between large veins on the outer leaves and these spots eventually are covered by a white mold, most commonly on the underside of the leaf. The spots eventually become brown. This white—fungus growth is seldom found on young plants but is commonly seen if heads reach maturity during humid weather.

Wind carries spores of the fungus from infected heads to others and if humidity is high an entire field of lettuce can soon become diseased. Spores are continually being formed on infected lettuce; therefore, it is advisable to disk under a field of lettuce immediately after it is harvested to avoid infecting nearby lettuce plantings. Wild lettuce can also be diseased so strict weed control is recommended.

Some control of mildew has been reported by the application of zineb dust or spray. It is therefore advisable to include this material when insecticides are being applied.

As mentioned before, high humidity favors the spread of this disease and for this reason it is wise to hold irrigations to a minimum when a field has become infected.

Crop rotation for a year will avoid the possibility that infection might spread from volunteer plants of the previous lettuce crop.

LETTUCE MOSAIC
Lettuce mosaic virus causes a downward rolling of the seedling leaf margins as well as a yellowing between the veins. The virus may also stunt the plant. Frequently, stunted plants fail to head at all, or if they do, the heads are small, light green, and commercially undesirable.

Transmission of lettuce mosaic virus takes place through infected seed and by aphids. Small percentages of seed (around 4 per cent) carry the virus. Some species of aphids then transmit the virus from diseased plants which have originated from infected seed.

So far as is known, all head- and leaf-lettuce varieties grown in Arizona are susceptible to lettuce mosaic virus.

The use of disease-free seed will help control lettuce mosaic. Numerous weeds also carry lettuce mosaic virus. Control of these either by roguing or other means within the
field as well as in surrounding areas is an essential part of a control program.

BIG-VEIN

In plants infected with big-vein virus, leaf veins and areas next to them lose their green color, become translucent and greatly enlarged. Leaves also become extremely puckered or savoyed. The margins of leaves of plants infected with big-vein become quite wavy and irregular. Such plants usually are late in forming heads and occasionally they may fail to head or the heads will be small.

Big-vein is apparently not seedborne. The virus is carried in the soil, but the exact manner of soil transmission is imperfectly known. The virus is concentrated in the roots of the diseased plants. Insects have not been found to spread big-vein virus.

All varieties of head lettuce grown in Arizona at the present time are susceptible to big vein.

No practical methods of controlling big-vein are known at the present time other than avoiding land that has a big-vein history. Since the disease is limited to lettuce, planting infested fields to any other crop is satisfactory. In other parts of the country, soil fumigation with such materials as formaldehyde and other compounds has been successful in controlling big-vein; however, such measures are impractical in Arizona.
# Production Cost Guide
## Fall Crop Head Lettuce

### SAMPLE COSTS

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>No. Times</th>
<th>SAMPLE COSTS</th>
<th>YOUR COSTS</th>
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¹Based on 1954-1955 survey of commercial costs for production of 500 cartons of fall lettuce per acre.
²All items of Land Preparation, Planting, and Culture, include labor, fuel, grease, but not overhead. (Not custom operator price.)
³General Farm Expense includes management, fence repair, general weed control, and miscellaneous items.
⁴Equipment Depreciation and Expense include depreciation on all equipment used to produce a fall lettuce crop.

*Adapted from information prepared by Ray L. Milne, Assistant County Agricultural Agent, University of Arizona Agricultural Extension Service, Maricopa County, Phoenix, Arizona.*
### Production Cost Guide
#### Spring Crop Head Lettuce

<table>
<thead>
<tr>
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<td>Fertilizer application</td>
<td>1</td>
<td>0.50</td>
<td></td>
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<tr>
<td>Floating</td>
<td>1</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Furrowing-out</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td></td>
<td>1.00</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>$7.90</td>
<td>0.017</td>
</tr>
<tr>
<td><strong>CULTURAL</strong></td>
<td></td>
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<tr>
<td>Cultivations</td>
<td>4</td>
<td>2.40</td>
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<tr>
<td>Insecticide applications</td>
<td>2</td>
<td>2.00</td>
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</tr>
<tr>
<td>Irrigations</td>
<td>6</td>
<td>4.20</td>
<td></td>
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<tr>
<td>Thinning</td>
<td></td>
<td>15.00</td>
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</tr>
<tr>
<td>“Doubles” thinning and weeding</td>
<td></td>
<td>15.00</td>
<td></td>
</tr>
<tr>
<td>Side dressing (fertilizer)</td>
<td></td>
<td>1.00</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>$39.60</td>
<td>0.088</td>
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<tr>
<td><strong>MATERIALS</strong></td>
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<tr>
<td>Insecticides</td>
<td></td>
<td>6.50</td>
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<tr>
<td>Irrigation water, 2½ acre feet SRVWUA Project</td>
<td>12.50</td>
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<tr>
<td>Seed - 2 lbs.</td>
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<td>7.00</td>
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<tr>
<td>Fertilizer: N + P₂O₅</td>
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<td>28.80</td>
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<td><strong>TOTAL</strong></td>
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<td>$54.80</td>
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<tr>
<td><strong>HARVESTING</strong></td>
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<td>Harvesting and Packing Labor</td>
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<td>108.00</td>
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<tr>
<td>Cartons, Pads, etc.</td>
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<td>135.00</td>
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<tr>
<td>Hauling</td>
<td></td>
<td>27.00</td>
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<tr>
<td>Miscellaneous and Inspection</td>
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<td>36.00</td>
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<td>Cooling and Loading on Car</td>
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<td>67.50</td>
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<td><strong>TOTAL</strong></td>
<td></td>
<td>$373.50</td>
<td>0.830</td>
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<td><strong>FARM OVERHEAD</strong></td>
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<td>General Farm Expense, 6 mo.</td>
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<td>34.00</td>
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<tr>
<td>Equipment Depreciation and Expense, 6 mo.¹</td>
<td>12.00</td>
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<td>Industrial Insurance</td>
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<td>9.80</td>
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<tr>
<td>Miscellaneous</td>
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<td>2.20</td>
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<tr>
<td>Interest on investment 6 mo. @ 5%</td>
<td>10.00</td>
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<td>Taxes, 6 mo.</td>
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<td><strong>TOTAL</strong></td>
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<td>$71.20</td>
<td>0.158</td>
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<td><strong>GRAND TOTAL</strong></td>
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<td>$547.00</td>
<td>$1.214</td>
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¹Based on 1954–1955 survey of commercial costs for production of 500 cartons of spring lettuce per acre.

²All items of Land Preparation, Planting, and Culture, include labor, fuel, brease, but not overhead. (Not custom operator price.)

³General Farm Expense includes management, fence repair, general weed control, and miscellaneous items.

⁴Equipment Depreciation and Expense include depreciation on all equipment used to produce a fall lettuce crop.

*Adapted from information prepared by Ray L. Milne, Assistant County Agricultural Agent, University of Arizona Agricultural Extension Service, Maricopa County, Phoenix, Arizona.*
Management Checklist
For Growing Head Lettuce
— Fall Grown Crop —
(Listed in Normal Sequence)

SOIL PREPARATION*
1. Plow
2. Float or drag (on landplane)†
3. Border (or corrugate)‡
4. Preplanting irrigation
5. Broadcast preplanting fertilizer
6. Disk
7. Float or drag

PLANTING AND GROWING
8. List or furrow-out
9. Plant
10. Irrigate (2 times)
11. Cultivate and refurrow
12. Irrigate
13. Roll bed (optional)
14. Thin seedlings
15. Cultivate and refurrow
16. Irrigate
17. Remove “doubles” and weeds
18. Cultivate
19. Fertilize (side dress as needed) and refurrow
20. Irrigate
21. Cultivate
22. Irrigate (2 or 3 times)
23. Harvest
24. Irrigate
25. Harvest

Apply insecticides as needed

*Some of the operations listed below are not always needed.
†Consult discussion in text under section on planting and seedbed preparation
on use of landplane.
‡Consult discussion in text under section on planting and seedbed preparation
on use of corrugation method for preplanting irrigation.
Management Checklist
For Growing Head Lettuce
— Spring Grown Crop —
(Listed in Normal Sequence)

SOIL PREPARATION*
   1. Plow
   2. Float or drag (or landplane)†
   3. Broadcast preplanting fertilizer
   4. Disk
   5. Float or drag

PLANTING AND GROWING
   6. List or furrow-out
   7. Plant
   8. Irrigate (1 time)
   9. Cultivate and refurrow
  10. Irrigate
  11. Roll bed (optional)
  12. Thin seedlings
  13. Cultivate and refurrow
  14. Irrigate
  15. Remove "doubles" and weeds
  16. Cultivate
  17. Fertilize (as needed) and refurrow
  18. Irrigate
  19. Cultivate
  20. Irrigate (1 or 2 times)
  21. Harvest
  22. Irrigate
  23. Harvest

Apply insecticides as needed

*Some of the operations listed below are not always needed.
†Consult discussion in text under section on planting and seedbed preparation on use of landplane.
MANY PUBLICATIONS AVAILABLE

This bulletin is available free from your County Agricultural Agent. The Agricultural Experiment Station and Agricultural Extension Service, both part of the College of Agriculture of the University of Arizona, publish many circulars, bulletins and reports dealing with all phases of agriculture and homemaking. If you want information on any particular subject go to your County Extension Office and ask your local County Agricultural Agent or County Home Agent for a publication helpful in solving your particular problem. This is a free service and you are urged to use it whenever it can be helpful to you.

Harold E. Myers
Dean
College of Agriculture
UNIVERSITY OF ARIZONA