Growing Cantaloupes in Arizona

May, 1956

BULLETIN 275

Agricultural Experiment Station

UNIVERSITY OF ARIZONA

Tucson

SUMMARY

VARIETIES adapted to Arizona are few. Imperial PMR #45 is the most popular for hot-capped and open-seeded crops. However, SR-91 is gaining in popularity for the early hot-capped crop. Arizona Sunrise, a recently introduced variety, has been used in the early hot-capped crop.

PLANTING DATE rauge is wide. Hot-capped melons in Yuma are seeded during early January. The open-seeded crop in Yuma is planted from late January through March. In the Salt River Valley planting begins in late February and continues through April.

SOIL selection and soil management are important factors affecting earliness and total yield. For earliness, the lighter, gravelly to sandy loams are preferred. Silt and clay loam types are important for maximum yields.

SPACING is an excellent way to control melon size and yield. Individual plants spaced 9 inches apart seems most desirable. Beds 80 inches wide are preferred in the Yuma area. The 60-inch bed predominates in the Salt River Valley.

IRRIGATION is perhaps the most critical cultural practice. The use of a preplanting irrigation is strongly urged. During the first irrigation the planted slope of the bed must be moistened beyond the seed line to prevent salt accumulation in the seed row. Lighter, but thorough, irrigations should be used during the melon sizing and maturation period. Maturing melons lying on wet soil may become soil marked, soft and rotted.

FERTILIZER nitrogen is the most important nutrient in cantaloupe production. However, large amounts must be avoided to prevent excessive vine growth at the expense of melon set and development. Under certain conditions, phosphate fertilizers are beneficial.

POLLINATION by bees is necessary for the setting of fruit. Fields supplied with plenty of honey bees produce about one-third more melons than fields having no hives in the immediate vicinity.

HARVESTING melons for highest quality requires frequent pickings. Melons harvested for shipping should have reached the "full-slip" stage of maturity and should be firm and well netted.

INSECTS most commonly found attacking cantaloupes in Arizona are leafminers, spider mites, melon aphids, leaf hoppers, and cucumber beetles. Control of these pests is based on the proper use of parathion, systox, and DDT, although the importance of beneficial insects should not be overlooked.

DISEASES are prominent controlling factors in cantaloupe production. The root-knot nematode is most commonly found in sandy soils. Control methods are crop rotation with grains, a weed-free summer fallow, or soil fumigation. Curly top, a virus disease, is carried by the beet leafhoppers. Eliminating these insects will control the disease. Powdery mildew is caused by a windborne fungus and is controlled by the use of PMR varieties plus Karathane dust applications.

TABLE OF CONTENTS ON BACK COVER

GROWING CANTALOUPES IN ARIZONA

W. D. Pew, R. B. Marlatt, and L. Hopkins[1]

The growing of cantaloupes[2] has occupied a position of prominence in Arizona's vegetable production from the very beginning of the industry in this state. As a crop, it is very well adapted to commercial production in the lower-elevation irrigated valleys of Arizona because of the low rainfall and the warm sunny days which are conducive to excellent production of quality melons. The dollar value of the cantaloupe crop is greater than that of any other summer-grown vegetable. Regardless of season, it ranks second in acreage among all the vegetables grown in Arizona; head lettuce ranks first.

The acreage devoted to the production of cantaloupes has more than doubled in the past 10 years. Most of this is due to increases in and around Yuma valley. In 1944, the total acreage devoted to this crop was 10,313 acres, of which 6,533 acres (63%) were in the Salt River Valley area. The remaining 3,780 acres (37%) were in the Yuma area. By 1955 the acreage had grown to 22,743 acres, of which 15,743 acres (69%) were in the Yuma valley area and 6,500 acres (29%) in Salt River Valley fields. The remaining 500 acres (2%) were in the Parker area. On a national basis, Arizona ranks second only to California in total cantaloupe production.

Because of their high quality, Arizona cantaloupes have gained considerable favor on many eastern markets. On any market they compete, saleswise, very satisfactorily with melons produced anywhere in the United States.

This bulletin is designed not only to be helpful to the experienced grower but also to provide the basic production information to those who lack experience in growing cantaloupes.

Soil Type

Perhaps cantaloupes are grown on the widest variety of soil types of any of our vegetable crops. To select the most nearly ideal soil type would be extremely difficult. However, from an evaluation of the various factors involved in selecting a soil, the loam or sandy loam type soils would be preferred. For very early crops where rapid maturity is the keynote the lighter gravelly to sandy loams are recommended. The heavier silt loams and clay loams are desired for maximum yields. It is important for a grower to know the soil type so that he can prepare the seed bed, fertilize, and irrigate it properly.

---

[1] **Horticulturist, Assistant Plant Pathologist, formerly Assistant Entomologist, respectively, University of Arizona.**

[2] **The term cantaloupe** *(Cucumis melo)* **for the purposes of this bulletin is synonymous with muskmelon.**

In the true sense of the words, the term muskmelon should technically refer to the plant and fruit thereof known as *Cucumis melo*. **The term cantaloupe should be used to designate the small, dark-skinned, netted muskmelon classified as** *Cucumis melo* **var.** *reticulatus*.

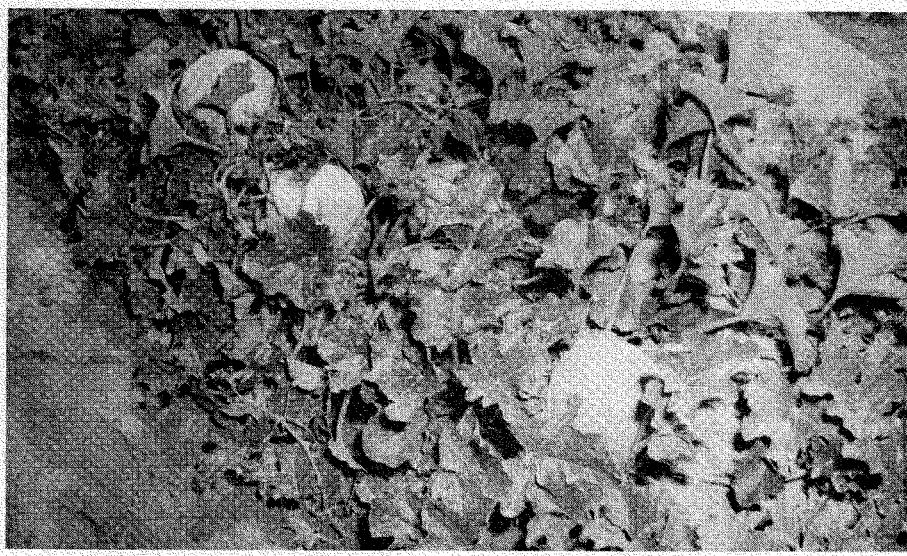


Fig. 1. PMR #45 Variety. Note excellent set of fruit and ample vine cover.

Varieties

Imperial PMR[3] No. 45

The Imperial PMR No. 45 is the major variety in commercial production in Arizona. Its vines are moderately large and vigorous and normally produce a large crop. The fruits are medium to large, oval, with indistinct ribbing, and well, but coarsely, netted. Its flesh is salmon colored, thick, firm and sweet. It has the typical muskmelon flavor and is an excellent shipping melon.

SR No. 91 (Sulfur Resistant)

SR No. 91 is used occasionally in commercial production. Because of its tendency to produce large fruits, and its long growing season, it is especially important in the hot-capped crop grown in the Yuma area. The plants are vigorous and productive. Fruits of this variety are large, short-broad-oval shaped with a dense, high net and tough rind. Its flesh is rich salmon to orange, very thick and of high quality. It is not as popular for shipping as Imperial PMR No. 45.

V-1 (Sulfur Resistant[4])

The V-1 variety is not currently a very popular variety. The plants are similar to SR 91 in that they are vigorous and productive. Its fruits are similar to those of Imperial PMR No. 45, being large, and oval, with dense, high netting and tend to be more rough in appearance. This variety is not as popular for shipping as Imperial PMR No. 45.

[3] **The letters PMR refer to Powdery Mildew Resistant.**

[4] **Sulfur resistant varieties are those varieties that may be dusted with sulfur for control of certain insects or diseases without danger of their being seriously injured.**

Arizona Sunrise

The Arizona Sunrise variety is a new introduction by the Horticulture Department of the University of Arizona.

This variety produces moderately large and vigorous vines which normally set fruits freely. Setting and maturing of the various "fruit-sets" occur over a comparatively short period. Consequently, a large percentage of the fruits can be harvested during the first pickings. The fruits are small to medium in size, spherical in shape, with a tendency toward round rather than football-shaped melons, which mature slightly earlier than those of the common commercial varieties. The melons have very indistinct sutures (ribbing), and are heavily but not deeply netted. The flesh has a deep orange color, thick (even at blossom end), somewhat soft, and quite sweet, with the typical muskmelon flavor. The chief disadvantages of the variety are its susceptibility to the powdery mildew disease, commonly a serious problem in the Yuma area, tendency to produce small fruits, and moist seed cavity.

Planting Dates

Because of the temperature differences in the combined major cantaloupe-producing areas of the state, the planting dates extend over a fairly long period. Seeding of the open-planted crop in the Yuma area begins during the latter part of January and continues into March. Planting in the Salt River Valley normally begins in late February or early March and continues throughout April. Where hot-capping is practiced, as in certain areas of Yuma valley, seeding is done in late December or early January. The caps in this case are removed when the danger of frost has passed. For fall-harvested cantaloupes, planting is done in June and early July.

Fig. 2. Hot-capping operation for early cantaloupes, Yuma district.

Planting Rates

The rate of seeding will depend to a marked degree on the date of planting. For very early melons, when the soil is colder than required for good, rapid germination, the use of 3 to 4 pounds of seed per acre is suggested. For seeding the mid-season and late crops, 2½ pounds of seed should be ample.

Planting and Seed Bed Preparation

Proper soil preparation for cantaloupes often makes the difference between a good or poor crop. The soil should be plowed or worked to a depth of 10-12 inches under average soil conditions to facilitate bed preparation and to allow for proper water penetration and soil aeration after the crop is planted. Excessive tillage or land preparation should be avoided.

The plants should be encouraged, through proper soil management practices, to develop a strong, extensive root system normal to this crop. Consequently, if a hard-pan exists in the upper two feet of soil, it should be broken up. This may be done by deep plowing, knifing, or any similar subsoiling technique.

After the soil is broken, the area should then be bordered and a preplanting irrigation applied. If time will not permit an irrigation at this point, the area should be given one, and not more than two, discings followed by a floating or smoothing operation in preparation for listing. If a preplanting irrigation practice is followed, the field, when sufficiently dry to work, should be disced and floated as described above.

In the Yuma area, beds are usually erected by means of a heavy-duty, bedding-type, tandem border disc. In some cases, however, heavy duty listers are used. Regardless of original method of bed construction, a ditching-type V with a planter attachment is used to shape the planted side of the beds during the planting operation. Because of the very flat fields and high sloping beds used in the Yuma area, the seed line is usually located approximately 20 inches up the slope.

In the Salt River Valley, bed preparation and planting methods vary from those in Yuma. Following the smoothing operation in land preparation, the area is listed or furrowed-out. This is done with a regular cotton-type lister equipped with 14-inch bottoms. The depth of the furrows in this case should be determined in relation to the type of sled to be used and the height and type of bed desired. Usually a furrow 7-9 inches deep is sufficient to make a smooth, firm, well-formed bed. Bed shaping and seeding are accomplished next and are done in one operation with a specially designed regular commercial sled-type planter.

The location of the seed row in reference to the bottom of the furrow will vary considerably with soil type and slope. The distance up the slope of the bed will range from 10-17 inches, measured from the bottom of the furrow diagonally up the slope of the bed. For steep, sloping fields, or on soils which "sub" water slowly, the seed line should be from 10 to 14 inches above the bottom of the furrow. For rather level areas and with soil which moistens easily the height would be 15-17 inches. In any event, the seed line should be well above the line of free water in the furrow during the irrigation applications.

For the early crops, the beds should extend east and west and the seed should be planted on the south slope of the bed. This procedure provides the fullest utilization of higher temperatures of a southern exposure. Where it is impossible to lay off rows in an east-west direction, an eastern exposure planting on north-south rows should be used when possible in order to take advantage of the forenoon temperature build-up and, consequently, a longer period of high temperatures each day. However, one precaution must be kept in mind. If the prevailing wind is from the west, it

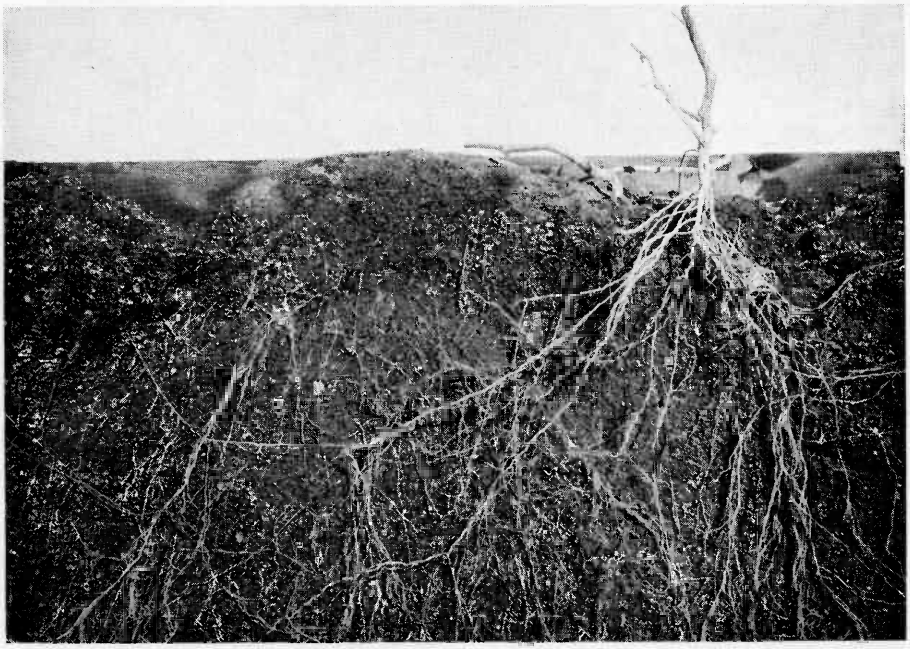
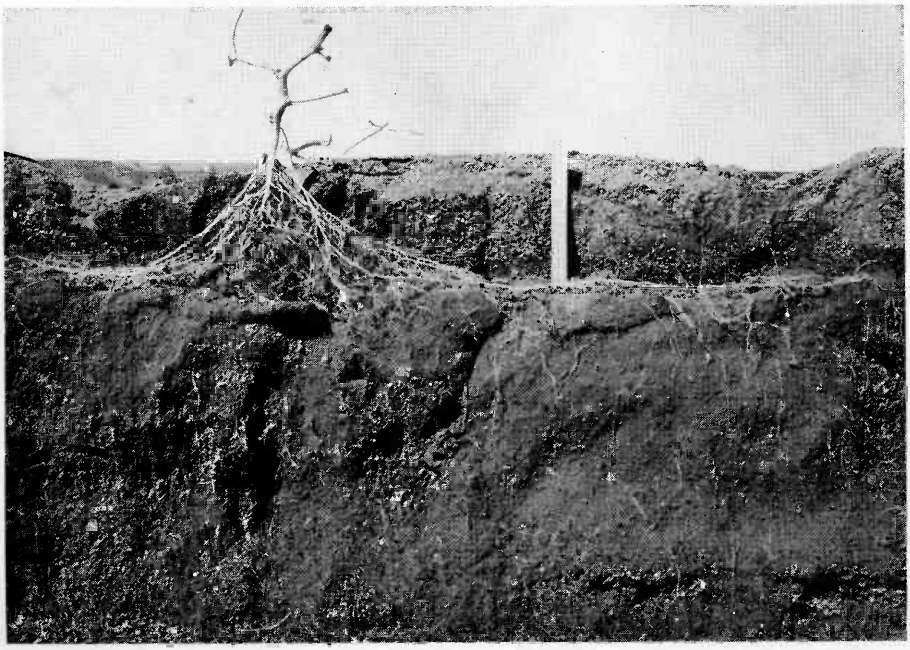
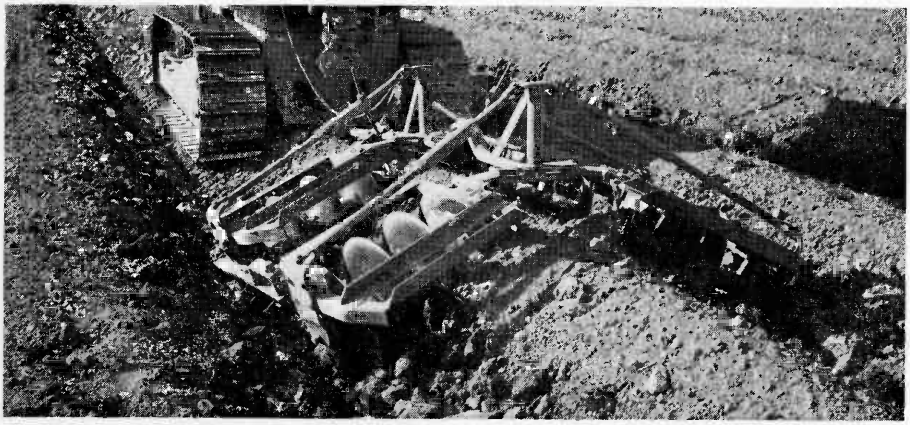


Fig. 3. Above: Normal, extensive root system. Below: Shallow root system affected by hard pan.





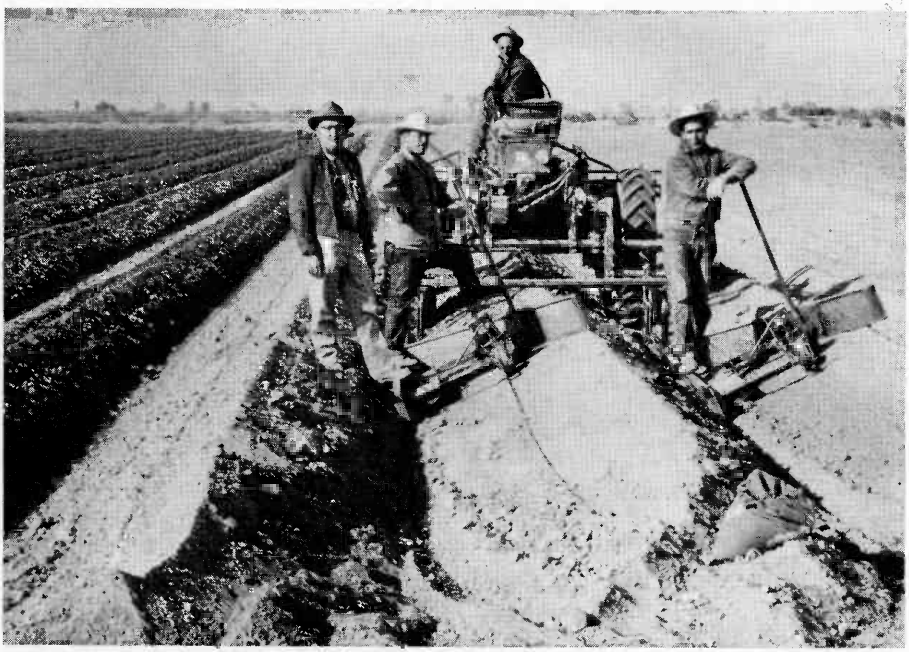


Fig. 4. Above: Heavy duty bedding-type tandem disc. Below: Ditching V with seeder attachment commonly used in the Yuma area.

may be wise to plant on the west slope of a north-south bed. This will prevent the vines, which are trained on to the bed, from being blown back into the furrow.

The seed should be placed in dry soil from ½ to 1 inch deep, well covered, and firmed with the packer wheel of the planting unit. After the planting is completed, the area is ready for the first irrigation.

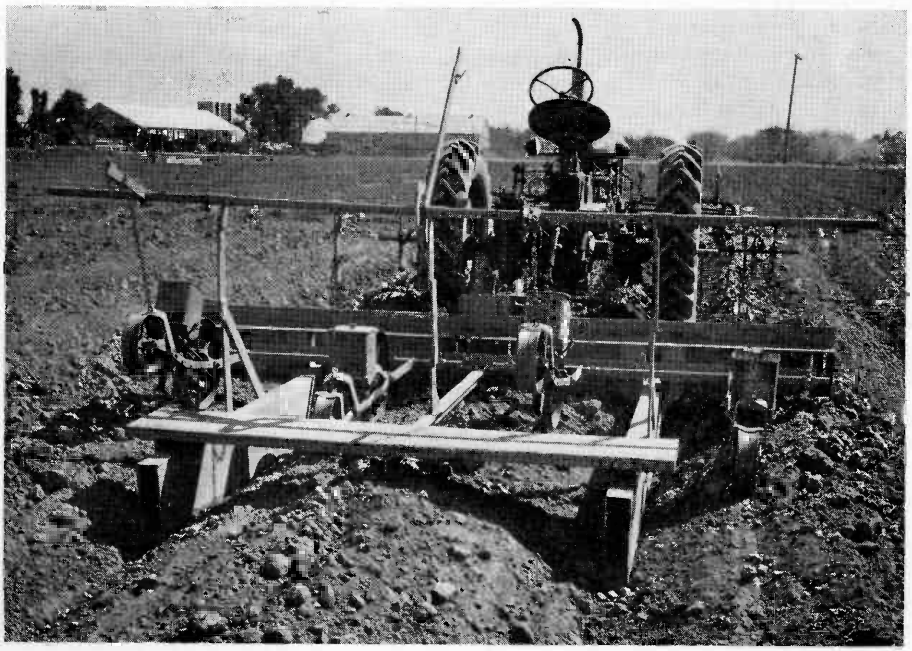


Fig. 5. Commercial sled-type cantaloupe planter, as used in Salt River Valley. Above: Front view. Below: Rear view.

Spacing

The distance between rows or beds will vary from 52 to 84 inches. In the Yuma area, the wider 72- to 84-inch beds are used, with the majority being 80 inches. Growers in the Salt River Valley almost universally prefer the 60-inch bed.

The equipment available for planting and cultivating must be considered when deciding on bed width. The beds should be wide enough to support ample foliage to cover the developing melons, but not so wide that the beds cannot be adequately covered by the vines. Planting on beds wider than can be properly covered by the vines is an inefficient use of the land and will result in less than optimum yields.

Plant spacing is a convenient and easy way to control melon size and yield. There are perhaps as many practices of plant spacing within the row as there are growers of the crop. Spacing will vary from single plants 6 inches apart to two or three plants, or hills of plants, as far as 36 inches apart. Experiments have shown that single plants spaced 9 inches apart produce the highest yields. This is particularly true on good cantaloupe soil where the crop is properly grown. The most popular spacing in Yuma is two-plant hills spaced 2 feet apart. Hilled or grouped plants are usually less efficient users of fertilizer and soil moisture than individually spaced plants.

Irrigation

Proper irrigation procedure is perhaps the most critical cultural practice in cantaloupe production in Arizona. From this standpoint, it is unfortunate that the preplanting irrigation is generally not included in the normal commercial preparatiton procedure for cantaloupes. Despite this fact, the use of a preplanting irrigation is strongly urged where time will permit and where one desires to replenish the subsoil moisture and/or where weeds may be a problem. In the event of a possible early weed problem, a preplanting irrigation will encourage weed seeds to germinate and sprout, thus making them vulnerable for easy destruction by a discing operation.

Following planting in dry soil, the "germination" irrigation is applied. The duration of this irrigation will vary depending on soil type, bed and seed line height, time of application, length of run, slope and season. However, it should be of such duration as to allow the beds to become moistened beyond the seed line and to saturate the inner portions of the beds. This type of wetting usually takes from 18 to 24 hours under commercial conditions. Moistening the beds just to the seed line is a poor practice because of the salt depositing action. This salt deposition will almost invariably result in poor germination and spotty stands.

If the soil is warm and good seed has been properly planted, a single irrigation should be enough to bring about germination and seedling emergence. However, if the soil is cold and germination and emergence are slow, or if windy conditions prevail, an additional irrigation may be necessary to get a stand established.

In any irrigation program one must do everything possible to encourage early extensive root development. Maximum root development will normally occur where the soil is kept moist but not wet. Keeping the beds too wet is con-

ducive to surface root development but retards and limits the deeper extensive roots so important in water absorption. Root systems of this type rarely are capable of supplying sufficient water to the plant during heavy-use periods when temperatures are high and the vines are transpiring rapidly. Likewise, plants should never be stressed for water. Keeping the soil too dry also reduces root development. Plants grown under either of these conditions are generally retarded and small and root production rather limited.

The second irrigation (or third as the case may be) is usually withheld until just before thinning to soften the surface soil, making thinning easier. If the soil is moist enough for thinning, this irrigation is applied just after thinning to initiate the forcing period and to distribute side-dressed nitrogen fertilizer.

The two irrigations following the thinning operation are very important. Each of these should be a heavy, soaking application to help build up the reserve moisture in the elevated bed area for use by the plant as the melons are maturing and when heavy water applications are not advisable. These two irrigations should be about 2 to 3 weeks apart. Subsequent applications should not be heavy, but should supply ample water for optimum plant growth. These irrigations should be made at 1- to 2-week intervals. One must be cautioned that these indicated periods for irrigations are very general and, as with other crops, the schedule should be determined by the condition of the plants and not by the calendar.

Irrigations when the melons are sizing and maturing should not be so heavy that the soil on which the melons are lying becomes wet. If this occurs the fruit may become "soil marked," soft, or begin to rot.

Applying irrigation water after the first harvest begins is not generally recommended on heavier soils that have received proper earlier irrigations. However, on the lighter soils, improperly handled heavier soils, or where an extended harvest period occurs, one must supply water to keep the vines from dying and thus prevent subsequent sun damage to developing and maturing melons.

Fertilization

Proper fertilization is another very important factor in cantaloupe production in Arizona. As with most other vegetables grown in Arizona, nitrogen is the fertilizer element which will have the most pronounced effect on the crop and the production received therefrom. However, under certain conditions, phosphate fertilization is also important in attaining maximum yields of good quality melons.

Since cantaloupes use fairly large amounts of nitrogen and respond remarkably to its use, melon growers should attempt to become acquainted with its proper use. In applying nitrogen to cantaloupes, it makes little difference which source you choose so long as it is applied correctly and at the same rate of nitrogen per acre. However, the use of sodium nitrate should be avoided, not because of the nitrogen but because of the added sodium. The presence of sodium in our soils is the cause for many of our soil structure difficulties and for this reason its use would be unwise.

An ample supply of available nitrogen for the cantaloupe plant early in the growth periods is very important. The quantity of nitrogen needed will depend largely on soil type, previous cropping history, residual fertility and several other fac-

Fig. 6. Left: Good fertilizer application. Right: No fertilizer application.

tors. Because of the wide differences in these factors on various soils the general requirements for nitrogen will range from 60 to 150 pounds of actual nitrogen per acre per crop.

Except on soils which normally respond to phosphate fertilization through improved crop growth or fruit quality, the beneficial use of this element is generally restricted to cantaloupes grown under hot-caps or those seeded very early in the season. The response by these crops appears to result from the fact that early-planted melons develop less extensive root systems than those planted later in the season. Where the root systems are somewhat restricted in growth, they are sometimes incapable of absorbing enough phosphorus for maximum plant growth and yield. Under these conditions additional phosphate is important. Where phosphates are deemed necessary, approximately 45 pounds of P_2O_5 should suffice.

An addition of fertilizer potash is not generally recommended because most soils used in cantaloupe production are well fortified with available potassium; the cantaloupe plant appears to be able to utilize this natural soil potash very effectively.

Many methods of fertilizer application are practiced under commercial production conditions. A program which is very effective and one which has given excellent results is to apply approximately two-thirds of the total amount of nitrogen fertilizer expected to be used, as a preplanting application, and worked well into the soil. The remaining one-third of the fertilizer in the program should be applied as a side-dressing. The early application may be broadcast, injected, or supplied in the water if a preplanting irrigation is used.

Another satisfactory method of applying fertilizer as a preplanting application is to band dry-type fertilizers into the beds. Either a single or double band may be used. If the single band is used, it should be placed 2 to 3 inches to the furrow side of where the seed row will be when planted, and about 6 inches deep. In the case of two bands, one should be placed as described above and the second should be located 4 to 7 inches toward the bed side and 8 to 10 inches below the surface. The final position of the two bands should be 6 to 10 inches apart and at about the same level in the bed. Care should be taken not to band nitrogen fertilizers

directly below the seed because of the danger of burning the roots of the young plants.

Nitrate forms of nitrogen fertilizer should not be used in the flood-type preplanting irrigation or as a broadcast application prior to this irrigation, because much of the nitrogen will be leached beyond the root zone.

If phosphates are to be used, the entire amount for the crop should be added as a preplanting application and worked into the soil. By applying fertilizers in such a manner the listing operation, in preparation for seeding, will fold the fertilizer out of the furrow area into the beds where the young plants will have ready access to it. If this preplanting application is impossible the phosphate should be applied as a side-dressing immediately following thinning and before the next irrigation. Likewise phosphates may also be injected or applied in the water immediately after thinning. The preplanting application method is preferred to the side-dressing method. Obviously, if the preplanting irrigation practice is used, liquid phosphate may be used.

The first and usually the only additional side-dressing application necessary should be applied following thinning and before the next irrigation. If, however, the plant's appearance shows a need for more nitrogen, another application should be made about the time the runners are 8 to 10 inches in length. Over-fertilization with nitrogen should be guarded against since it may produce excessive vine growth at the expense of melon set and development.

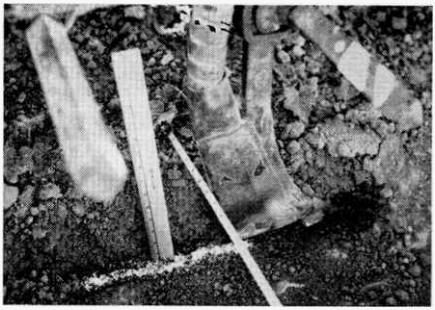


Fig. 7. Placement of sidedressed nitrogen fertilizer.

Preplanting injections of fertilizer should not be deeper than 6 to 8 inches. For injection placement as a side-dressing application, the fertilizer should be placed approximately 6 to 8 inches to the furrow side of the plant row and 6 inches deep. The position of banded side-dressing of dry fertilizers after the plants are established and thinned is from 4 to 6 inches to the furrow side and 3 to 4 inches below the seed level or just deep enough to cover the fertilizer with soil. The application of side-dressed nitrogen in the irrigation water is often a very effective and efficient method.

It should be the aim of a fertilizer program to insure a good fruit set and to keep the plants in a vigorous growing condition after thinning so that ample vine is produced to cover the developing melons.

Vine Training

As the plants grow and the vines begin to develop, the runners should be trained away from the irrigation furrow onto the elevated beds to prevent interference with irrigation, cultivation, and harvesting. Such training also prevents wetting and subsequent water-marking or spoiling of the melons. The vines should be handled with care to avoid breakage. Although the vines should be trained in rather compact rows over the crowns of the plants and higher portion of the beds, they should not be rolled or handled so the undersides of the leaves are exposed to the sun when the turning is completed.

Cultivation

There are only a few good reasons why cultivation of a melon crop may be necessary.

1. To control weeds (certainly the most important factor).

2. Mulch area to facilitate proper side-dressing or injection of commercial fertilizers.

3. To loosen top soil as an aid to water penetration (break surface crusts).

4. Allow for soil aeration.

5. To assist in moving the furrow farther away from plant row as the plant begins to grow. (By the time that runners are developing rapidly, the plants should be approximately 15 to 18 inches away from the center of the furrow.)

In cultivating the unplanted side of the beds while plants are young, a special springtooth harrow is a very effective and efficient tool. After each cultivation, the furrow should be re-established about 3 to 4 inches farther away from the plant line than the previous furrow until the plant row is approximately 15 to 18 inches from the center of the furrow. Regardless of the distance the furrow is moved away from the plant line after each cultivation, extreme care should be taken to keep a smooth slope from furrow to plant line. Carelessness in re-establishing the furrow after early cultivations will result in a depression between the old slope of the bed and the slope established by the new furrow. This depressed area becomes wet through subsequent irrigations and does not dry as quickly as the exposed higher adjacent surfaces. This depression being close to the crown of the plant is usually the area on which the crownset melons lie as they develop. Because this area remains wet, the melons in contact with this soil often become soil- or water-marked and, consequently, unmarketable when ripe. Moving the furrow to greater distances than 15 to 18 inches from the plant is not recommended since it becomes increasingly difficult to get proper water penetration during later irrigations.

Chemical Weed Control

The use of chemicals to control weeds in cantaloupes is showing considerable promise. Results from preliminary tests have shown that the sodium salt of N-1-naphthyl phthalamic acid — commonly marketed as Alanap-3 — is an effective weedicide for many broadleaf weeds and annual grasses that are a problem in cantaloupe fields. This chemical is, not, however, effective against a few broadleaf weeds, particularly the puncture vine, *Tribulus terrestris.*

So far, the best results have been obtained by the application of 6 pounds of Alanap-3 (active ingredient[5] over-all acre basis) in 50 gallons of water per acre. Alanap-3 is manufactured as a liquid and is readily soluble in water. It remains in solution without stirring; conse-

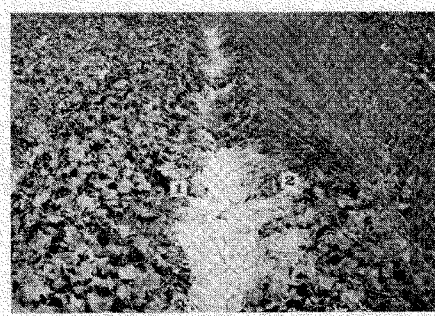


Fig. 8. Weed control in cantaloupes. Left: Alanap treated. Right: Untreated.

[5] **Alanap-3 contains 2 pounds of active ingredient per gallon.**

quently, no spray tank agitation is necessary. The spray should be applied at 40 to 50 pounds pressure as a pre-emergence application following planting and before the germination irrigation. Use a metal rather than a wooden tank sprayer because of ease in cleaning. Clean all spray equipment thoroughly after use. For hot-capped melons, the application should be made after planting and before the caps are placed over the seed.

After the spray has been applied, care should be taken not to disturb the soil in the sprayed band any more than is absolutely necessary. Stirring the soil causes a marked reduction or loss of the weed-controlling value of this chemical; consequently, close cultivation to loosen or mulch the soil should not be done. Likewise, thinning should be put off as long as possible and, when thinning, neither deep nor broad cuts should be made. Shallow and short cuts with the thinning hoe will disturb the least amount of soil.

For both open-seeded and hot-capped melons, the 1-foot-wide band or strip treatment directly over the seed row is recommended. Care should be exercised in calculating the pounds of material needed where the band or strip application is used. One must remember that 6 pounds of active ingredient per acre is the rate for the entire area of an acre. If the treated area is a strip 1 foot wide on a 5-foot bed, the 6-pound rate will be enough to treat 5 field acres (1.2 pound per field acre). Using the 1-foot-wide strip method on an 80-inch (7½-ft.) bed, the 6-pound rate will treat 7½ acres. This would mean that .8 of a pound of active ingredient would be applied per field acre.

Pollination

The cantaloupe plant produces two kinds of blossoms. The flowers that appear first produce pollen only. Those that appear later bear pistils (female parts) and thus are the only ones capable of producing fruit. This condition accounts for the failure of the first blossoms to set fruits.

These two types of blossoms can easily be distinguished. On the fruit-bearing type, a small, undeveloped fruit can be seen at the base of the blossom even before it opens. To cause fruits to develop, pollen must be transferred by bees to the pistils of these blosoms.

Undersized or more often misshapen melons may be the result of poor pollination. Of the insects observed visiting cantaloupe flowers, the honey bee has been found to be the most effective pollinator. If enough bees are present in a cantaloupe field during the blooming period, the flowers will be properly pollinated and an ample fruit set generally results.

There should be one honey bee colony per acre of cantaloupes to get adequate coverage and thorough pollination. The colonies may be placed on the edges of the field or in the field itself. Honey bees can be found in practically all Arizona melon fields and it may seem unnecessary to supply additional colonies; however, it has been shown that fields supplied with plenty of bees produce about one-third more melons than fields having no hives in the immediate vicinity.

In locating the bee colonies, it is important that they be placed under some sort of shade to protect them from the hot sun. The colonies may be placed in the shade of trees adjacent to the field, or the grower may construct temporary shades similar to those used for cattle.

Fig. 9. Field picking.

Harvesting

Harvesting normally begins during the middle of May for capped melons and late in May for early open-planted melons in Yuma valley. For early seedings in the Salt River Valley, the melons will be ready for harvest during June. Harvesting the later-planted melons in this area will continue through July.

The fields are usually picked every other day although at the peak of production the melons may be picked every day. The melons, when properly matured for shipping, should be "full slip,"[6] firm, and well netted. Melons are hand picked into commercial citrus picking bags by field crews, dumped into field trailers or specially designed trucks, and transported to the packing sheds.

At the packing sheds, the melons are sorted and packed in crates according to their size. Several sizes are packed. These are: 23, 27, 36, or 45 jumbo melons-per-crate and are referred to by these numbers as 36's, 45's, etc. Generally speaking, the 36-melon-per-crate size is the most desirable. With the very early melons grown under caps, two additional sizes are added, pony 45's and 54's.

Yields

As with most other perishable produce, the market price at harvest time plays a distinct role in determining the actual harvested yields. For example, with a poor or slow market the yield will be correspondingly less because, under these conditions, field picking and shed grading are more precise and only melons of most desirable size and quality are taken, with the remainder being left in the field or discarded as culls at the packing sheds.

The usual commercial yield ranges from 115-200 jumbo crates per acre. Excellent yields are from 235 to 275 jumbo crates per acre.

[6] **"Full slip" refers to the maturity condition when the stem pulls away from melon with slight pressure of the thumb leaving a smooth scar with no torn tissue.**

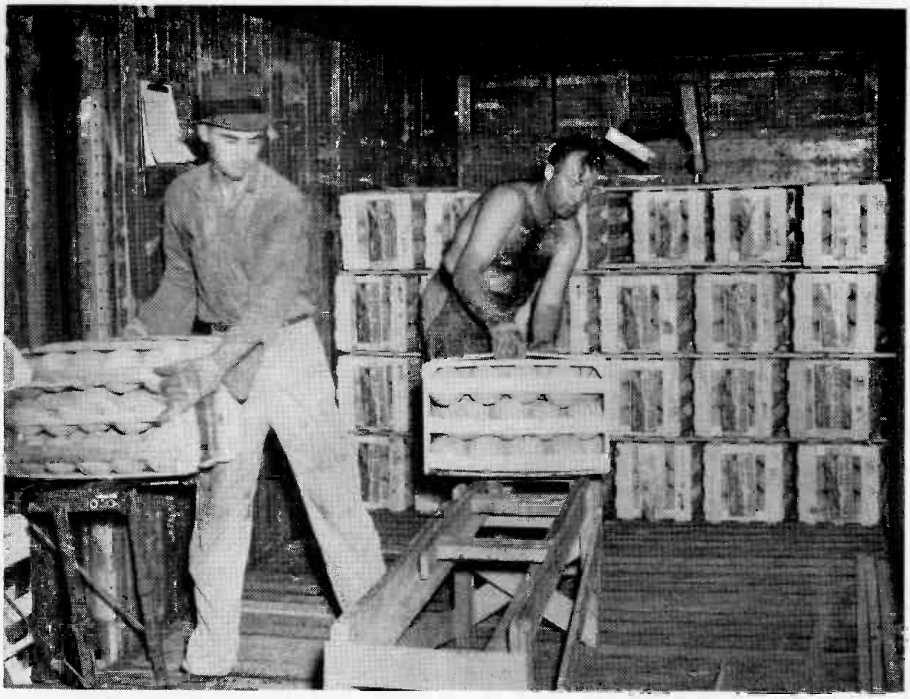


Fig. 10. Refrigerator car loading. Crate in foreground is popular 36-melon-per-crate size.

Insects and Spider Mites

LEAF MINERS: *Liriomyza spp.*

Leaf miners attack cantaloupes from the time the seedlings emerge until the fruits are harvested. They may do considerable damage and plants may be destroyed when populations are heavy. The female flies lay their eggs individually inside the leaf tissues and one leaf may contain several eggs. After hatching, the larvae make tunnels by feeding within the leaves. The diameter of the mines or tunnels increases as the larvae grow. Older leaves are attacked first and, when tunnels are numerous, infested leaves may wither and die. When the larvae are mature, they emerge from the leaves and pupate, usually dropping to the ground, but occasionally remaining on the leaves. Adults are small flies about 1/16 inch long, mostly black in color, with a yellow spot on the back just forward of the wings. The abdomen may appear to be banded.

Leaf miner larvae are attacked by a large number of parasites and, if parasitization approaches 50 per cent, insecticide treatments are probably not needed. A good indication of parasitization is the presence of dead leaf miners within the leaf. When leaf miner populations are low, treatments may be delayed until an average of from 10 to 15 mines per leaf are found on the center leaves of the plants, or until infestations begin to spread. If infestations appear to be increasing rapidly, as indicated by the presence of many small mines in the younger leaves, insecticide applications should be

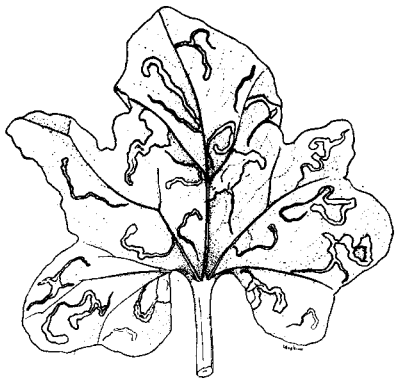


Fig. 11. Leaf miner damage to cantaloupe leaf. Note numerous mines or tunnels.

made. Leaf miner adults and larvae are killed by dust or spray applications of parathion, although pupae are not affected. A second application, after an interval of ten days, is needed to reach newly emerged flies and to properly control heavy infestations. Two per cent parathion dust, applied at the rate of 25 pounds per acre, may be used. A spray containing ¼ to ⅜ pound of actual parathion per acre, in sufficient water to give a good coverage, may also be used. Such a spray would be prepared, for example, by adding one to one and one-half pints of an emulsion concentrate, containing 2 pounds of parathion per gallon (usually termed a 25 per cent emulsion concentrate), to the desired amount of water per acre.

SPIDER MITES: *Tetranychus telarius* (Linnaeus), *Tetranychus desertorum* Banks.

There are several species of mites that attack melons. The most common one is the two-spotted spider mite, *Tetranychus telarius*, although the desert spider mite *Tetranychus desertorum* is common in some areas. The two-spotted spider mite may be red or straw-colored, but the desert mite is bright carmine in color. Life history and controls for each are about the same.

Spider mites are very small but are easily visible to the naked eye. They prefer the lower leaf surfaces on which to develop, and usually cover such surfaces with silk webbing. The female mites lay clear, round eggs on the leaves under the webbing. In the summer, populations build up rapidly, since the mites are able to complete their life cycle in 10 days or less.

Mite feeding results in the removal of green matter from leaves, causing them to become pale. Heavy infestations cause a bronzing of the leaves, which may eventually dry up and die. Light infestations may be tolerated, but large populations definitely affect the growth of the plants and the quality of the fruits.

Factors that favor mite outbreaks are dryness, dust, weeds near or in the fields, and applications of insecticides such as DDT or dieldrin. The reason for these build-ups is not clearly understood, although predator reduction is certainly a contributing factor.

Natural enemies that aid in keeping mites under control include the minute pirate bug (*Orius*), six-spotted thrips, ladybird beetles and predacious mites. Under favorable conditions, these natural enemies will prevent serious mite outbreaks.

Spider mites may be effectively controlled on cantaloupes with a spray containing four to six ounces of demeton (Systox) per acre in sufficient water for proper coverage. This spray may be prepared, for example, using 1-1½ pints of a 23 per cent demeton (Systox) emulsion concentrate, containing 2 pounds of active ingredient per gallon, for each acre treated. This systemic insecticide has sufficient residual persistence to kill the young that hatch from the eggs. Demeton (Systox) has been approved by the United States Food and Drug Ad-

ministration for use on cantaloupes, provided a residue tolerance of 0.75 parts per million is not exceeded at harvest. To comply with this requirement, cantaloupes should not be treated within 21 days of harvesting.

Although dust or spray applications of parathion (used at the same rates as suggested above for leaf miners) are very effective against both immature and adult mites, the eggs are not affected. Parathion deposits are not sufficiently persistent during the cantaloupe growing season to adequately control newly-hatched mites emerging over a period of several days after a treatment. For this reason, more effective control may be expected when a dust containing 2 per cent parathion and 7½ per cent Ovotran (to kill eggs) is used.

MELON APHID: *Aphis gossypii* Glover

The melon aphid is a widespread and destructive pest of cantaloupes. It is also a pest of cotton. It may be found on cantaloupes from the time the first leaves emerge until the crop is harvested.

The melon aphid is a small, dark species that ranges from yellowish-green to greenish-black in color. It develops in colonies on the undersides of leaves. Under favorable conditions, populations develop rapidly, and may be detected by the downward curling of the leaves around the aphid colonies. The leaves stop growing and become twisted and knotted. In serious infestations, the plants are eventually killed. It is not uncommon on heavily infested plants to find the leaves sticky with honeydew and covered with white cast skins of aphids. When colonies become crowded on a single plant, many winged aphids are produced which fly to other plants. A temperature of about 68° F. is most favorable for aphid development, although their insect enemies are not able to reproduce as readily at such a low temperature.

Chemical control of the melon aphid should be adjusted to the activity of such natural enemies as ladybird beetles, aphid lions and small parasitic wasps. If aphid populations build up rapidly when few natural enemies are active, there may be a need for insecticide applications.

The melon aphid may be effectively controlled by applications of demeton (Systox) or parathion, as suggested for the control of spider mites and for leaf miners, respectively. Malathion is also effective as a 5 per cent dust (applied at the rate of 30 pounds per acre), or in a spray at the rate of 10 to 15 ounces of active ingredient per acre. The latter concentration is obtained, for example, when 1-1½ pints of 57 per cent malathion emulsion concentrate, containing 5 pounds of active ingredient per gallon, or 10 ounces per pint, are used per acre in sufficient water for proper application.

BEET LEAFHOPPER: *Circulifer tenellus* (Baker)

This is a gray to greenish-yellow insect, about ⅛ inch long (Fig. 10). It is the only known transmitter of an important virus disease known as curly top (p. 26), which may kill or seriously stunt young cantaloupe plants or affect the development and yields of older plants.

Beet leafhoppers breed on weeds such as sowbane, lambs quarters and careless weed but not on cantaloupe plants, which are not their preferred food. When weeds are present in cantaloupe fields, the beet leafhoppers hop back and forth between the weeds and cantaloupe plants, thereby exposing the latter to infections of curly top.

Beet leafhoppers are best elim-

inated from cantaloupe fields by early and thorough weed control. Two per cent parathion dust (without sulfur) may be used when necessary to control beet leafhopper migrations into unweeded cantaloupe fields, although all weeds should be removed as promptly as possible after treatment. Selection of healthy plants by delayed thinning also helps to reduce curly top damage.

SOUTHERN GARDEN LEAFHOPPER: *Empoasca solana* (DeLong)

WESTERN POTATO LEAFHOPPER: *Empoasca abrupta* (DeLong)

These leafhoppers, which are very similar in appearance, are uniformly green in color and somewhat smaller than the beet leafhopper. Unlike the latter, they breed readily on cantaloupes and are of importance because of direct feeding injury. The eggs are deposited in the stems and the nymphs develop on the underside of the leaves. The nymphs and adults feed on the leaves, particularly of older plants, and produce many small white spots or specks where feeding has removed the normal green color. Older leaves are usually affected first. When leafhoppers are abundant the leaves may be severely injured, which in turn may lower the quality of the harvested fruit. Developing cantaloupes may also be subject to sun injury as a result of the damaged foliage. These insects are usually most numerous within 2 to 3 weeks of the harvest period and may be readily controlled by a single dust application of 2 per cent parathion or 4 per cent malathion (avoid formulations containing sulfur).

CUCUMBER BEETLES: *Diabrotica undecimpunctata* Mann.; *Acalymna vittata* (F.); *Diabrotica balteata* Lee

These are medium-sized yellow and black-spotted (*Diabrotica undecimpunctata*), striped (*Acalymma vittata*), or banded (*Diabrotica balteata*), beetles of usually minor importance in Arizona, but which occasionally cause significant damage to cantaloupes. The larvae feed on the roots and may destroy the vines, although usually the plants are stunted rather than killed. The larvae may attack the fruits where they touch the ground. Adult beetles feed on the above-ground portions of the plant, attacking both foliage and fruits, producing undesirable scars on the rind of the latter. The beetles

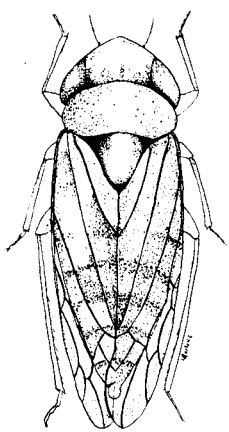


Fig. 12. The beet leafhopper.

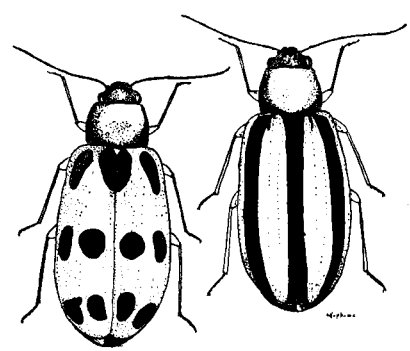


Fig. 13. Spotted cucumber beetles.

prefer to feed on the shaded lower surface of the fruit next to the ground. When field inspections are made, the fruits should be turned, and the bottom surfaces examined for feeding injury.

Control treatments should be based on the beetle populations present. Young plants should be treated at the first sign of damage, although older plants are able to withstand heavier populations. Parathion, as recommended for leaf miner control, will also control cucumber beetles. Other effective dust formulations are 5 per cent malathion, 2 per cent dieldrin, or 50 per cent cryolite, applied at the rate of 15 to 20 pounds per acre by ground equipment or 25 to 30 pounds per acre by aircraft. Dieldrin or cryolite formulations should not be used within 30 days of harvest. The use of dieldrin is conducive to heavy infestations of spider mites. Although DDT dusts are effective against cucumber beetles, heavy applications may create infestations of spider mites or leaf miners.

Other insects, such as cutworms, crickets, darkling beetles, grasshoppers, and thrips, may occasionally injure cantaloupes. Crickets, cutworms or darkling beetles may be controlled with 5 or 10 per cent chlordane dust applied at a rate of from 15 to 25 pounds per acre. Grasshoppers may also be controlled with chlordane, although formulations of dieldrin or aldrin are even more effective. Thrips may be controlled with 2-per cent parathion.

Sulfur and toxaphene are injurious to cantaloupe foliage and should never be included in insecticide formulations applied to this crop. Parathion is extremely toxic to humans and livestock and must be used with due regard for safety precautions. Malathion, parathion, and dieldrin cause serious injury to honey bees and should not be applied near hives or in the vicinity of blossoms that are being visited by bees.

Diseases

Root-knot Nematodes

Meloidogyne spp.

If plants grow slowly and exhibit symptoms similar to those suffering from lack of water even though the soil is moist, the roots should be examined for root-knot disease. The disease is evidenced by "knots" or swellings on the roots which are caused by very small worms, nematodes, too small to be seen readily without the aid of a microscope.

When a plant is severely damaged by nematodes, the leaves may be yellowish or yellowish-green and the entire plant is stunted or it may even be killed. Affected plants may wilt in the afternoon while healthy ones do not.

Root-knot nematodes are especially common in sandy soils and once they become established in a field it is impossible to get rid of all of them. However, there are methods for reducing the population sufficiently so that cantaloupes can be grown for one season without being damaged to any appreciable extent.

If an infested field is planted to winter grains and sorghum for 1 or 2 years, most of the nematodes will die of starvation. A summer fallow, if weeds are kept to a minimum, is another good method for reducing root-knot nematodes.

Soil fumigation, if done as directed by the manufacturer of the fumigant, is another method of reducing the number of nematodes in the soil. Soil temperatures must be within a range of 50° to 85° F. for efficient fumigation. Prior to fumigation, a field should be flooded, and as soon as it is sufficiently dry, should be worked into a good seed-

Fig. 14. Nematode damage. Note irregular swellings or "knots" along roots.

bed condition free of large clods and debris. The over-all type of fumigation is recommended for a cantaloupe crop. Merely fumigating the plant row would not be enough. A corrugated roller, cultipacker, or a drag is used to seal the fumigant into the soil. A waiting period of about two weeks is required between fumigation and planting.

All of these practices must be repeated before each crop of cantaloupes because the nematode population will be greatly increased after a single melon crop.

Curly Top

If plants are infected by curly top when they are very young, they may be severely injured or killed. Leaves on diseased plants are often smaller, runners are shorter, and if fruits are formed they may be unmarketable. Plants that are infected later than the 4-leaf stage are merely stunted, but yields are probably reduced.

Curly top is indirectly caused by the feeding of beet leafhoppers. Some of these small insects inject a virus into the melon plants during the feeding process and the virus causes the disease.

Leafhoppers prefer to feed on weeds, such as sowbane and lambsquarters, rather than cantaloupe plants. If a cantaloupe field or surrounding area is infested with these weeds, the plants grown in such fields are more likely to show curly top.

Once the cantaloupe plant is infected, the disease cannot be con-

trolled. Effective weed control in and around cantaloupe fields and control of leafhoppers are the best means of controlling curly top. This is especially important early in the season when the plants are young. (For leafhopper control, see the section on insects in this bulletin.)

Mosaic

Mosaic is another virus disease which is carried by insects; in this case aphids are involved. The mosaic virus is also carried within the seeds and, being on the inside, seed treatment with a disinfectant will not control the disease.

Leaves on a mosaic-infected plant are often shaped irregularly and exhibit light-green and dark-green mottling patterns. The surface of the leaf is frequently uneven and puckered; this is especially true of leaves near the tips of the runners. Plants with mosaic may produce fruits that are small and misshapen and consequently unmarketable.

In addition to being carried in seed and by aphids, the mosaic virus can be carried from a diseased plant to a healthy one by mechanical means, such as by workers while turning the vines or by equipment moving through a field.

As in the case of curly top, a diseased plant cannot be cured. Avoid planting cantaloupes next to alfalfa, beets, carrots, celery, honeydews, potatoes, and watermelons, which are often infested with aphids; and practice strict weed control in the field as well as around its edges, along fences, and ditch lines. Application of insecticides for controlling aphids in the field has not been a satisfactory means of preventing mosaic because more of the insects reappear as soon as the effects of an insecticide have "worn off."

Crown Blight

If a plant has crown blight, the older leaves near its base gradually die. This leaf killing continues along the runners until only the very tips may bear green leaves. One side or the tip of a leaf may be killed first and gradually the dead area covers the entire leaf blade. The stem of the leaf (petiole) frequently becomes yellow before it too turns brown and dies.

The cause of crown blight is not yet known, but the effects of the disease have been somewhat diminished by providing adequate amounts of nitrogen fertilizer and water to stimulate vine growth. If vines are kept growing vigorously, sufficient foliage can be formed to replace the leaves which are killed and thus provide shade for the fruits when vines are turned.

Powdery mildew

Erysiphe communis Wallr. ex Fries

On a plant infected by the powdery-mildew fungus, small, white, powdery spots appear on the under-

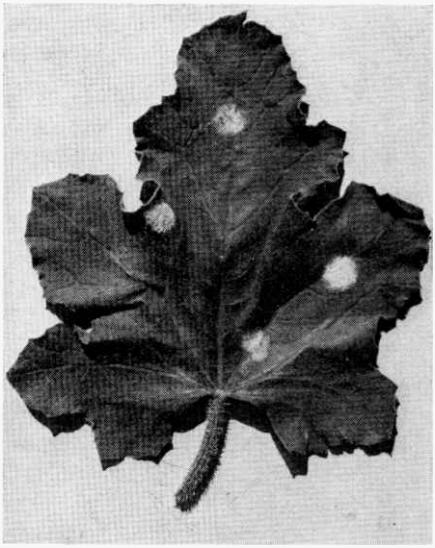


Fig. 15. Powdery-mildew spots on cantaloupe leaf.

side of older leaves. As the disease becomes more severe, these spots enlarge, run together, and leaves become pale-green before dying. The stems and young leaves may be attacked in severe cases. Fruits ripen prematurely and may be small, irregular, and sunburned.

The white, powdery appearance is due to the presence of millions of spores which are carried by wind and thus spread the disease. In addition to cantaloupes, these spores can also come from diseased honeydews and other melons, cucumbers, squash, watermelons, and ornamental or wild gourds.

On sulfur-resistant varieties such as V-1 and SR-91, sulfur dust may be applied for a certain amount of control. Even sulfur-resistant varieties may be slightly injured by applications of sulfur dust. *Sulfur should never be applied to other varieties.*

A powdery-mildew resistant variety such a PMR No. 45 does not become as severely diseased as the susceptible varieties; however, during a year when the disease is severe, additional control measures must be provided.

The disease is best controlled through the use of a powdery mildew-resistant variety plus the application of Karathane dust. Karathane is a relatively new material which has been effective at concentrations as low as ¾ per cent dust.

Occasionally, other diseases may become a problem in cantaloupe fields. If this should happen, it is suggested that you contact your County Agricultural Agent.

ACKNOWLEDGMENTS

The authors wish to express thanks to those who read the manuscript leading to this bulletin, and who made helpful suggestions and contributions. These include: Frank E. Todd, USDA Beekeeping and Insect Pathology Section, Agricultural Research Service, Tucson; Orin A. Hills, Truck and Garden Crop Insects Section, ARS, USDA, Phoenix; L. A. Carruth, head, Department of Entomology, University of Arizona; R. B. Streets, head, Department of Plant Pathology, U. of A.; W. H. Fuller, Associate Biochemist, U. of A.; Ray L. Milne, Assistant County Agent, Maricopa County; and John H. O'Dell, County Agricultural Agent, Maricopa County.

PRODUCTION COST GUIDE — CANTALOUPES*

	No. Times	COSTS[1] per acre	per crate	YOUR COSTS per acre	per crate
LAND PREPARATION AND PLANTING[2]					
Plowing[3]	1	$ 2.50			
Land Planing or Floating	1	1.25			
Discing	1	.75			
Furrowing out	1	.50			
Shape Beds and Planting	1	1.00			
TOTAL		6.00	.035		
CULTURE[2]					
Insecticide Applications	2	2.00			
Cultivations	4	2.80			
Irrigations	8	10.20			
Fertilizer Applications	2	1.20			
Thinning and Hoeing	1	7.00			
Turning Vines	3	7.50			
TOTAL		30.70	.181		
MATERIALS					
Insecticides	2	5.60			
Irrigation Water (SRVWUA)	3 A/ft.	15.00			
Seed	3 lbs.	4.59			
Fertilizer — 50# N, 50# P_2O_5 Planting Time		13.65			
40# N Thinning Time		7.60			
TOTAL		46.44	.273		
HARVESTING					
Picking		45.90			
Hauling		23.80			
Packing Labor		61.20			
Shook (box, top slats, nails, etc.)		108.80			
Labels, ice, hauling culls, inspection, loading, etc.		45.90			
Miscellaneous (power, foreman, etc.)		20.40			
TOTAL		306.00	1.800		
FARM OVERHEAD					
General Farm Expense — 6 Mo.[4]		18.10			
Equipment Expense and Depreciation—6 Mo.[5]		14.00			
Industrial Insurance		1.20			
Interest on Investment — 6 Mo. @ 5%		10.00			
Taxes — 6 Mo.		3.00			
TOTAL		46.30	.272		
GRAND TOTAL		435.44	2.56		

[1] Based on 1955 survey of commercial costs in Salt River Valley for production of 170 crates per acre yield.

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

[3] Renovating may be substituted where cantaloupes follow winter vegetables. Renovating cost per acre $1.25.

[4] General Farm Expense includes management, fence repair, weed control and miscellaneous items.

[5] Equipment Expense and Depreciation include depreciation on all equipment used to produce the cantaloupe crop.

***Adapted from information prepared by Ray L. Milne, Assistant County Agricultural Agent, U. of A. Agricultural Extension Service, Maricopa County, Phoenix, Arizona.**

MANAGEMENT CHECKLIST FOR GROWING CANTALOUPES

(Listed in normal sequence)

SOIL PREPARATION* (Yuma and Salt River Valley Areas)

1. Plow (Use of renovator may be substituted if crop follows winter vegetables)
2. Pre-planting irrigation
3. Disc
4. Land plane or float
5. Fertilize (broadcast application) (optional)
6. Bed preparation

   Yuma area

   a. Bedding or Listing
   b. Pre-planting irrigation (optional)
   c. Disc beds after irrigating

   Salt River Valley area

   a. List or furrow-out
   b. Not applicable
   c. Not applicable
7. Fertilize (band placement) (optional)

PLANTING AND GROWING (Yuma and Salt River Valley areas)

8. Shape beds and plant
9. Irrigate
10. Irrigate (optional)
11. Cultivate
12. Thin and hoe
13. Fertilize and refurrow (side-dress by banding, injection ribboning, or in irrigation water)
14. Irrigate
15. Cultivate and refurrow
16. Irrigate
17. Turn vines
18. Cultivate and refurrow
19. Irrigate
20. Turn vines
21. Cultivate and refurrow
22. Fertilize (optional)
23. Irrigate
24. Turn vines
25. Irrigate, 2 applications
26. Harvest period
27. Irrigate during harvest period, if necessary

    Dust applications (2 or more) Apply as needed to control insects.

* Some of the listed operations are not always necessary.

ORGANIZATION

Board of Regents of the University and State Colleges of Arizona

ERNEST W. MCFARLAND (ex officio), A.B., M.A., J.D., LL.D.....Governor of Arizona

CLIFTON L. HARKINS (ex officio), B.A., M.A.....State Superintendent of Public Instruction

JOHN G. BABBITT, B.S.....Term expires January, 1957

MICHAEL B. HODGES, Treasurer.....Term expires January, 1957

JOHN M. JACOBS.....Term expires, January, 1959

EVELYN JONES KIRMSE, A.B., A.M.....Term expires January, 1959

ALEXANDER G. JACOME, B.S., Secretary.....Term expires January, 1961

WILLIAM R. MATHEWS, A.B., President.....Term expires January, 1961

LYNN M. LANEY, B.S., J.D.....Term expires January, 1963

SAMUEL H. MORRIS, A.M., J.D., LL.D.....Term expires January, 1963

RICHARD A. HARVILL, Ph.D.....President of the University

ROBERT L. NUGENT, Ph.D.....Vice-President of the University

Experiment Station Administration

HAROLD E. MYERS, Ph.D.....Director

RALPH S. HAWKINS, Ph.D.....Associate Director

ARLAND R. MEADE, B.S., M.S.....Editor

CONTENTS