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CULTURE of PIMA
and
UPLAND COTTON
in ARIZONA



EXTENSION OF COTTON CULTURE into the drier regions of the Southwestern States is one of the consequences of the invasion of the eastern Cotton Belt by the boll weevil. Cotton already is the chief product of several of the irrigated valleys, and a large increase of production is to be expected if high prices continue.

This bulletin describes the methods used in growing cotton in the Salt River Valley, Arizona, including the selection and preparation of the land, planting, thinning, irrigation, cultivation, and the harvesting of the crop. The information has a general application to the irrigated districts where cotton is grown in New Mexico, Arizona, and California.

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CULTURE OF PIMA AND UPLAND COTTON IN ARIZONA¹

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COTTON is now a major crop in several of the irrigated valleys of the Southwestern States. Costs of producing and marketing are higher under western conditions, but it is possible to secure large yields of superior fiber. Precautions are needed in the selection of land, in maintaining supplies of good seed, and in the cultural treatment of the crop. Failures are usually caused by neglect of cultural operations or of proper irrigation. An understanding of the requirements of the crop is essential to a better utilization of the resources of production. The object of this bulletin is to describe cultural methods which have proved successful in the Salt River Valley and adjacent districts, including the preparation of the land, planting, irrigation, and cultivation of the crop.

The information is based primarily on experience in growing the Pima variety of Egyptian cotton, but the requirements of Upland cotton in the irrigated southwestern valleys are not essentially different. Regarding some features in which slight differences have been observed, the treatment of the two types has been discussed separately.

SELECTION OF A VARIETY

Commercial conditions have not been favorable for Pima cotton since the war period, chiefly on account of the fact that large importations of cotton could be made from Egypt at relatively low prices because of the restricted use of Egyptian cotton in Europe. Many farmers have stopped growing Pima and are planting Upland cotton. Prices of Egyptian cotton did not advance in the seasons of 1922 and 1923 in proportion to the advance in Upland cotton, so that

¹ This bulletin is largely a revision of *Farmers' Bulletin 577, Growing Egyptian cotton in the Salt River Valley, Arizona*, by E. W. Hudson, and of material from other publications, including—

Camp, W. E. *Cotton culture in the San Joaquin Valley in California*. U. S. Dept. Agr. Circ. 164, 22 p., illus. 1921.

King, C. J. *Crop tests at the cooperative testing station, Sacaton, Ariz.* U. S. Dept. Agr. Circ. 277, 40 p., illus. 1923.

_____. *Water-stress behavior of Pima cotton in Arizona*. U. S. Dept. Agr. Bul. 1018, 24 p., illus. 1922.

Martin, R. D., and H. F. Loomis. *Summer irrigation of Pima cotton*. Jour. Agr. Research, v. 23, p. 927-946, illus. 1923.

the growing of Upland cotton is likely to continue until the market outlook for Pima is definitely improved. Also, it is believed by many farmers that Upland cotton is much more productive than Pima.

A large acreage was planted to Upland varieties of cotton in the Salt River Valley and adjacent districts in 1922 and 1923. High yields were secured in many cases and low yields in others. In a series of side-by-side comparisons of Pima and Upland varieties conducted on very fertile soil at the United States Field Station, Sacaton, Ariz., for the last three seasons, 1921-1923, the Pima variety yielded equally well with Lone Star, Acala, Durango, Mebane, and Hartsville, though the last two varieties were included for only one season. In some comparisons with Pima at Sacaton pronounced differences have been shown in favor of Acala, and cases are reported in the Salt River Valley of lands where previously Pima had not given good yields, but where satisfactory crops of Upland cotton were produced in 1922 and 1923. These soils may continue to give better yields of Upland cotton than of Pima, or results may be different in seasons less favorable to the Upland varieties.

The highest yields are to be expected from Upland cotton when sufficient numbers of bolls are retained. The larger size of the bolls is an advantage for Upland cotton, but it is often counteracted by a greater tendency to shedding, so Upland varieties may yield less than Pima in adjacent plantings. To determine the relative productiveness of the two types of cotton will require careful comparison and checking of results for several years to cover the range of seasonal conditions.

Though experience with Pima cotton has shown the need of holding to one variety, so that supplies of pure seed may be developed and maintained, there has been much diversity of interest and opinion regarding the several Upland varieties represented in the valley.

It might not be impracticable to maintain supplies of pure seed of Pima and an Upland variety in the Salt River Valley, since the two types of cotton, as well as hybrids between them, are easily distinguishable. Hence, any mixing or crossing could be detected readily in the inspection and roguing of the seed fields. But it would be a much more difficult problem to maintain supplies of good seed if several Upland varieties continue to be grown in the valley. Mixtures or hybrids among the more similar Upland varieties could be distinguished only by breeding experts, so that effective isolation and roguing of several seed stocks would be very difficult and expensive, if not entirely impracticable.

The Acala variety, acclimatized in recent years from Mexico, apparently is well adapted to the conditions of the southwestern irrigated valleys, and supplies of good seed are obtainable in Arizona and California, so that there is no occasion to import seed from weevil-infested regions.

SELECTION OF LAND FOR COTTON

Cotton can be grown successfully on practically all of the irrigated lands in the Salt River Valley and adjacent districts. A fairly rich, deep, sandy loam soil is regarded as the best type of land because the cultural operations and irrigation can be handled to the best ad-

vantage. Other types of soil will grow good crops of cotton in proportion to their fertility, texture, and other cultural qualities. Soils that are too heavy take water very slowly, while very light soils lose water too rapidly, making it more difficult to grow good crops of cotton.

While some of the raw desert land has made good crops, better cotton can be grown, and at a lower cost, on land that has been in alfalfa. Most of the new land does not hold the water so well and requires more frequent irrigations; also, much of the new land is very uneven with spots of light soil which have to be irrigated separately if a uniform growth is to be maintained.

Alkali soils often grow excellent crops of cotton, though the plants may be injured if the salts are permitted to accumulate in the surface root zone during the period of active growth. The chief difficulties encountered on alkali soils are in securing a stand and in keeping the plants sufficiently watered in the fruiting period. Seedling plants are easily killed by salts that accumulate in the surface soil occupied by the roots, so that the stand frequently is poor. Also, alkali soils are often less pervious and take water slowly. After the fruiting stage is reached frequent flooding is necessary to keep the plants from being checked and shedding most of the crop. Some lands with a high water table may show salt on the surface and yet be able to grow good crops of cotton. In such cases no irrigation may be necessary during the entire season except the preliminary application before planting. It is not advisable to plant cotton on land that has many hard, impervious spots, locally known as "slick spots," because of uneven stands and difficulties of uniform irrigation.

SLOPE OF THE LAND

Land that is well leveled will require less water and will produce the most uniform cotton. The best grade to be given will depend somewhat upon the character of the soil, a steeper grade being permissible in light soils, which take water readily. Heavy soils will not become thoroughly wet unless the water can be held on the surface for some time or unless small heads of water are run for longer periods. Land that has too much slope is difficult to irrigate properly, and the fields are likely to dry out in spots, which must be irrigated separately if injury to the cotton is avoided. Where alfalfa land is put in cotton it is often advisable to change the plan of irrigation and bring the water from a different direction in order to secure a lighter grade.

PREPARATION OF THE LAND

Methods of preparation depend largely upon the condition of the land, whether weedy or clean, and upon the nature of the preceding crop. For land overrun with Johnson grass, preparation should begin in August with a shallow plowing, only 2 or 3 inches deep, then allowing the soil to dry out thoroughly. This is followed by a thorough disking and harrowing, thus dragging as many of the roots to the surface as possible. A spring-tooth harrow may be used to advantage in this work. During November or December another shallow plowing is given, and the soil is then pulverized by disking and harrowing. At this time the fields are gone over in both direc-

tions with orchard cultivators or similar tools having long teeth, to bring as many of the grass roots as possible to the surface, where they may be raked together and burned or hauled off the field. The land is then left fallow until the latter part of February.

In preparing to plant cotton on alfalfa land which is not overrun with Bermuda or Johnson grass, the same general plan can be followed, but with less disking, harrowing, or cross-plowing. If alfalfa land is plowed 2 or 3 inches deep, turned up to the sun until thoroughly dry, and later plowed 6 to 8 inches deep, very little alfalfa will survive to give trouble during the following season. Though alfalfa land may be prepared at any time prior to the planting season, it is better to plow first in October or November and again in January. Specially designed moldboard plows can be used to advantage in breaking up old alfalfa fields on sandy or loamy soils, in order to prevent subsequent growth from the roots.

In preparing cotton land for planting again to cotton, a stalk cutter should be used to chop the stalks into small pieces. Stalks that are too rank and woody to be broken by a stalk cutter are dragged down or cut by hand, then raked together and burned. The land should then be plowed, disked, and harrowed until in good tilth, when it may be left until planting time.

Bermuda grass is not so hard to eradicate as Johnson grass. It is possible by shallow plowing in November or December, followed by thorough disking and harrowing during the winter, to put Bermuda grassland in shape for cotton, if free from Johnson grass. Freezing will help to kill the roots if the winter preparation is thorough. Two or three weeks before planting, the land should be plowed from 4 to 6 inches deep and thoroughly pulverized.

To keep the Bermuda grass from reestablishing itself, regular cultivation must be kept up until the cotton plants are large enough to shade the ground. It may be necessary to chop out the grass and weeds in the rows at the time the cotton is being thinned, and in bad cases once or twice afterwards.

PREPARATION OF THE SEED BED

Thorough preparation of the seed bed during the winter gives the best prospect of a large crop, and less work is required during the summer.

Land previously in cotton or grain can usually be put in satisfactory condition by one plowing, while land previously in alfalfa should be plowed twice. It depends upon the kind and condition of the soil whether a double plowing is necessary to put the land in good tilth or whether this can be done by a single plowing, with double disking and double harrowing.

During the latter part of February, borders are thrown up about 2 rods apart. Before planting time the land should be flooded and then disked and harrowed as soon as sufficiently dry.

If the soil is very heavy it may be necessary to plant on ridges or beds, for the reason that land of this character may have to be irrigated in order to germinate the seed. The beds may be made 3½ feet wide and 8 inches high, but should be reduced to not more than half this height before planting. A smoothing drag can easily be constructed of 2 by 6 inch scantling that will take two or three beds

at a time. It should carry weight enough to drag off the surface clods and get down to the moist soil. Bedding is usually unnecessary, since if pulverized sufficiently, well irrigated, and placed in good tilth before planting, most of the soil of the Salt River Valley will hold moisture enough to bring up the seed without further watering.

TIME AND METHOD OF PLANTING

No definite date for planting can be set, since much depends upon the seasonal conditions. The rule is that cotton should be planted as early as possible with assurance of securing a stand. Early planting is desirable not only to secure the advantage of the longer season but because the young plants are likely to show more normal habits of branching and fruiting if very hot weather is not encountered during the early stages of growth. Experiments conducted with the Pima variety at Sacaton, Ariz., from 1917 to 1922, inclusive, indicate that the best time for planting is about the middle of March. But in some seasons cold weather or even frosts may continue in March, and it is better to wait two or three weeks longer, or until the weather is favorable. If the ground is too cold the seeds rot or germinate very slowly, and many of the seedlings are unable to push through.

With Upland varieties, such as Mebane, Acala, Durango, or Hartsville, there is less need to plant early, since Upland cotton requires less time to develop and mature a crop. In some cases good yields of Upland cotton have been secured from fields that were planted after the first of June. Thus it is possible for Upland cotton to follow winter crops of grain or truck. However, early planting of Upland cotton varieties is advised when possible, so that a fair crop of bolls may be set on the lower branches before hot weather.

On land enriched by previous crops of alfalfa, cotton should be planted in rows $3\frac{1}{2}$ or 4 feet apart. On new desert land or land that has been in grain but not in alfalfa the rows need not be more than 3 to $3\frac{1}{2}$ feet apart. The wider rows are recommended so as to permit the sunlight to reach the lower branches even when the plants grow rather large, as they usually do on fertile soil with plenty of water.

Satisfactory results may be obtained with either a 1-row or a 2-row planter, the latter giving a more uniform depth of planting.

—Except in very heavy soils flat planting is to be recommended, using a special shoe or lister attachment to push away dry soil and reach a moist seed bed. This device is very simple and easily made, either of wood or of iron. It fits down over the original planter shoe and is readily adjusted. The loose dry surface soil is pushed back and the seed placed in moist earth at a uniform depth (fig. 1). The double-disk device with which some types of planters have been equipped in recent years has also been found very effective for this purpose, though somewhat more expensive.

The depth of planting is varied to meet the conditions. For normal early plantings seed should be not less than 1 inch or more than 2 inches deep. If the soil is in perfect condition and there is moisture enough to insure prompt germination and bring the young plants above ground, 1 to $1\frac{1}{2}$ inches is a sufficient depth to plant. Later plantings may need greater depths, from 2 to $2\frac{1}{2}$ inches, especially on light sandy soils that dry out quickly. Only as much land

should be irrigated at one time as can be prepared and planted before the soil becomes too dry to germinate the seed. Otherwise, a poor stand is likely to result. Except on heavy soils it is important that the harrow, drag, and planter be as close behind the disk as possible. If the soil is left in clods instead of being pulverized, the upper layers are likely to dry out very rapidly, especially when high winds occur, which are frequent at planting time. Many of the poor stands obtained in some seasons can be attributed to the drying of the soil in the seed bed.

To insure a good stand in early plantings it is advisable to use 30 to 40 pounds of seed to the acre. In later plantings under ordinary conditions 25 pounds will give satisfactory results. Some growers

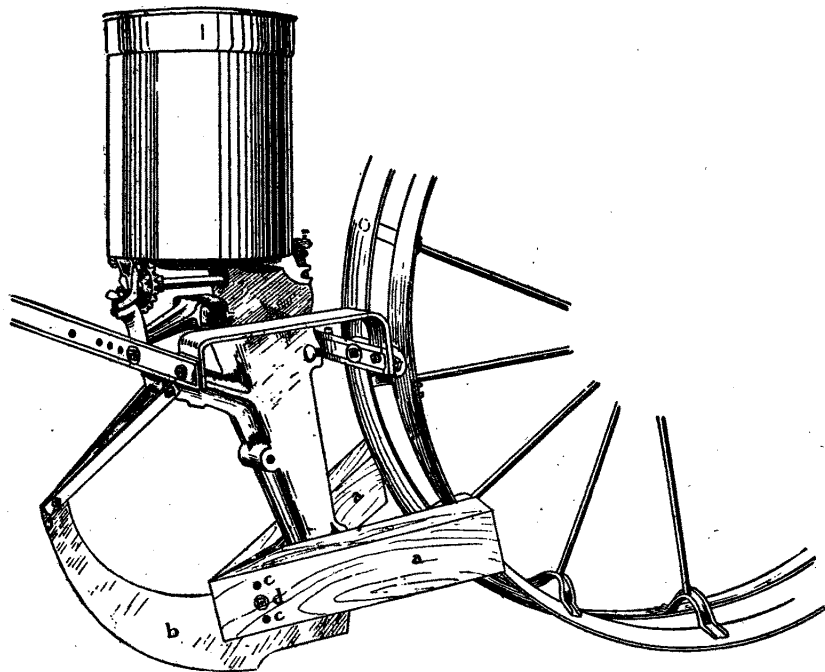


FIG. 1.—A planter attachment used to push away the dry surface soil: *a, a*, The 2 by 4 wings; *d*, bolt used to fasten the wings to the shoe. Additional holes, *c, c*, can be put in the wings, so that they may be lowered or raised as desired, and the depth of covering the seed may be regulated in this way

use only 12 to 15 pounds of seed per acre and get fairly good results, though there is less assurance of a regular stand. Several seedlings together may lift a crust from which a single seedling could not emerge.

It is not advisable to flood the land after planting, because a crust is formed and the young plants may be unable to break through. Beds are used on very heavy lands and water run in the furrows, so that the ridges are moistened by seepage and the formation of a crust is avoided.

CULTIVATION

A shallow cultivation is given as soon as the plants are well out of the ground, to break any crust which may have formed, to dry

and warm the surface soil, and to kill the weeds. It often is possible on clean land to make the first cultivation with a drag or spike-tooth harrow. Otherwise, a disk cultivator is preferable for the first or first two cultivations. For later cultivations small shovels and sweeps are preferable, because they kill more weeds and leave the land in better condition.

As soon as there is no danger of covering the plants, the soil should be gradually worked toward them at each cultivation. Some of the weeds are covered, and a small ridge is thrown up along the row, which makes it easier to control the later irrigations. After each irrigation the ground should be stirred until the plants are too large to be cultivated. More frequent cultivation is required in some fields to keep down weeds and maintain a good mulch on the surface. This is especially true early in the season, when irrigations are likely to be several weeks apart.

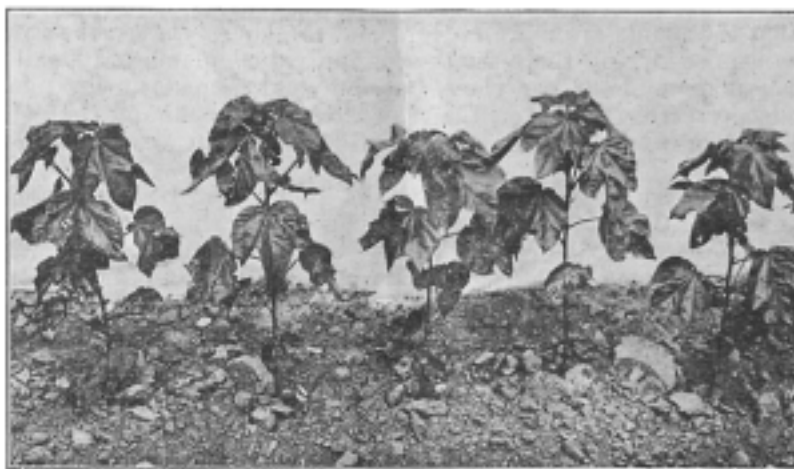


FIG. 2.—Normally developed Pima cotton plants at an early stage soon after thinning, with the first fruiting branches not yet showing beyond the leaves

On land that breaks into large clods following irrigation, wooden rollers, or "cultipackers," can be used for crushing the clods and putting the soil in proper tilth. A riding cultivator may be used until the plants are too tall, when a 1-horse walking cultivator is required. The late cultivations also should be shallow, so as not to interfere with surface roots.

SPACING OF PLANTS IN THE ROWS

Thinning to 12 or 14 inches is customary, the wider spacing of former years being generally abandoned (fig. 2). The thinning, more often called "chopping," is usually done when the plants are about 6 inches high. Good results are secured from this method under favorable conditions in the Salt River Valley.

Experiments have shown that larger yields may be obtained with closer spacings than 12 inches, especially under conditions where the plants grow rank and have too many vegetative branches that close the lanes between the rows, as well as at the other extreme where the plants remain small and restricted in size. Plants spaced

to 6 or 8 inches or two plants per hill at 12 inches have better chances of setting good crops under either of the extreme conditions. In open stands with the plants at an average distance of 2 to 4 inches apart in the rows, thinning may be unnecessary, or it may even reduce the yield, as shown in several experiments with Upland cotton in Texas.

Very early thinning, before the plants are 5 or 6 inches high, is not advisable. In the seedling stage the mutual protection is an advantage, so that the young plants make better growth and there is less danger of losing a stand through sand storms, sore-shin, or cutworms. On rich alfalfa land it is better to delay thinning until the plants are 10 or 12 inches tall, except that with spacings of 6 inches or less or with two or more plants in a hill there is no occasion to delay thinning.

The advantage of closer spacing and later thinning is explained by the fact that the vegetative branches or side stalks are suppressed, so that the plants are more upright and the lanes between the rows remain open during the season. The individual plants are smaller and bear fewer bolls per plant, but the yield is made up by more plants per acre. Moreover, the crop is easier to pick and the bolls open earlier where rank growth is avoided, so that frost injury is reduced.

The same principles apply to the thinning of the Upland cottons as to Pima. Under favorable conditions and with the long growing seasons of the Salt River Valley good yields may be had with any spacing from 3 inches to 2 feet, but it does not appear that the wide spacings offer any definite or regular advantages to compensate for the serious losses that often result when the plants grow too large and crowded and fail to mature a crop before frost.

Farmers who plant cotton late, after winter grains or truck crops, are advised to pay particular attention to spacing and thinning. Late-planted cotton is more inclined to rank growth, and if very luxuriant it may fail to set fruit or may produce only a late crop that fails to open before frost. It appears logical to argue that because late-planted cotton is likely to grow rank, the plants should have wider spacing in the rows, but in reality the danger of rank growth renders close spacing more necessary with late plantings. To get the maximum crop from late-planted cotton the plants should stand only a few inches apart, to insure a suppression of the vegetative branches and induce a quick setting of a crop of bolls.

EARLY IRRIGATION

If the soil contains the proper amount of moisture when the seed is planted and is well cultivated, no irrigation may be required for six weeks or two months after planting. Then a light furrow irrigation may be given, followed by cultivation as soon as the ground is dry enough to work.

If the field is not in good condition after one cultivation it should be gone over a second time as soon as possible; in any event within 10 days or two weeks. Under ordinary conditions it will not be necessary to irrigate again for three or four weeks, when another light irrigation should be given, followed by a thorough cultivation. These two irrigations should carry the crop until about July 1. It

is understood that cultivation should always follow any rains that may come.

It may be necessary to irrigate more frequently on new land, which usually will not retain moisture so well as land that has been in crop, particularly alfalfa. New land usually has to be irrigated at least three or four times before July 1. Also some old land may require an extra irrigation during this period if serious wilting occurs. But wilting of some of the plants during the early stages of development is not conclusive evidence that a general irrigation is needed. Even with plenty of moisture in the soil the young plants may be wilted by warm weather following a cold period. When the change from cool to hot weather is very abrupt and the difference between day and night temperature is great, the plants may require two or three days to adjust themselves.

Irrigation is not required so long as the plants are growing vigorously. With Pima cotton the lack of water is indicated suf-



FIG. 3.—Normally developed Pima cotton plants at the beginning of the fruiting stage, when summer irrigations begin. Note the development of fruiting branches and the suppression of vegetative limbs

ficiently in advance by the wilting or drooping of the leaves in the hot hours of the day, though irrigation may be delayed until the leaves show signs of wilting before noon. A little wilting on a very hot day does not necessarily indicate a need of irrigation, especially if the weather has turned hot suddenly after a cool period.

The reason for irrigating sparingly during the first part of the season is to avoid the too rapid growth of the plants. If the plants enter upon a rank, woody growth they are likely to maintain this tendency throughout the season at the expense of fruitfulness (figs. 3 and 4). More attention should be given to the spring treatment of cotton, so as to have the plants in a normal fruiting condition when summer irrigations begin. The treatment cotton receives before flowering begins is undoubtedly reflected in all of the subsequent behavior of the plants and is a factor in determining the water requirements during the fruiting period. When a normal fruiting condition is attained, the summer irrigation problems are simplified, since the plants are not so easily forced into rank growth by the

application of water in excess of the actual requirements. (See fig. 3.)

SUMMER IRRIGATION

The application of water in July, after the early stages of growth are past and the plants are flowering and fruiting, is determined by the need of the plants. The object is to maintain regular growth and productiveness, as shown by abundant flowering and by little or no wilting of the leaves in the middle of the day.

In addition to the wilting of the leaves, the position of the flowers on the plants is another guide in determining the need of water. As long as the plants are growing well, the flowers are low down and come near the top only when the growth slackens. Growth should continue during July and August so that the flowers are

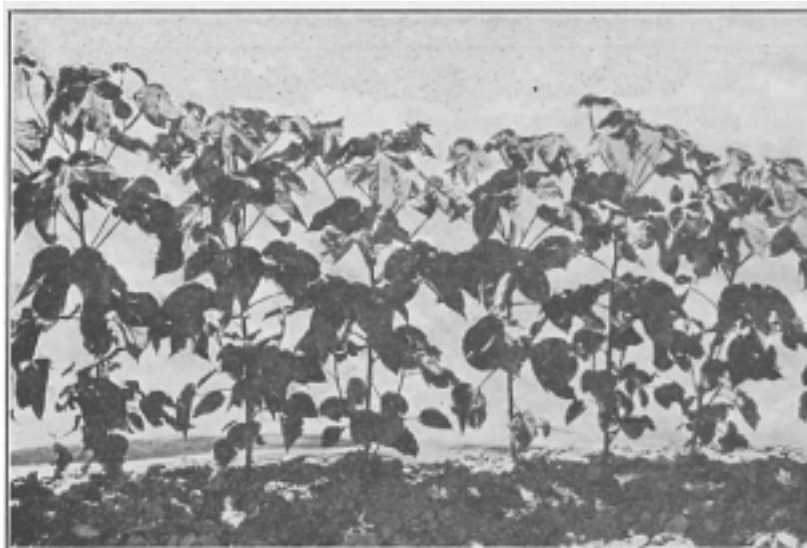


FIG. 4.—Pima cotton plants growing somewhat too rank, as indicated by the larger leaves and less prominent fruiting branches in comparison with Figure 3, as well as by the development of vegetative branches from the lower joints of the stalks

kept well down on the plants, the top of the field showing largely leaves and squares, with relatively few flowers in sight. (Fig. 5.) When the flowers can be seen in the tops of the plants and a decided yellow color is noted in looking over the field, it is evident that irrigation has been postponed too long.

Another method that growers frequently use for determining the need of watering a field of cotton is to watch the plants on the lighter spots of soil, and when these plants show wilting before noon the whole field is irrigated. But care should be taken not to overgrow the cotton in the better soil in an effort to save that on a few sandy spots.

In comparison with adjacent plantings of Upland cotton it has been noted that the leaves of Pima cotton wilt more quickly and that the Upland cotton is more adversely affected by wilting, as shown by the heavy shedding rates of squares and young bolls.

Thus it appears that greater care may be needed in the irrigation of Upland cotton, after flowering has begun, to avoid the stress condition that is indicated by wilting of the leaves.

A definite indication of the need of water in Upland cotton that will serve to prevent wilting and yet not "overgrow" the crop has not been detected, but there are several points that may be useful to inexperienced growers in determining the need of water. After flowering begins the plants should grow steadily, but not luxuriantly. The upper leaves should be of medium size, rather deeply lobed, and of a leathery texture, instead of the plants being forced, so that they develop large, coarse, broad-lobed, "elephant-ear" leaves. The squares at the top should be rather prominent in a well-grown plant



FIG. 5.—Normally developed Pima plants at the midseason stage. Note the medium-sized leaves and open foliage, the branches all of the fruiting type with numerous squares and young bolls

instead of being mostly hidden by the leaves, as on large luxuriant plants.

Another plant character to be observed in Upland cotton is the reddish color of the main stalk and the stems of the leaves, which increases with the age of the parts. Thus the approach of the red color to the terminal bud shows that growth is being checked and quite probably that water is needed. The reddish coloration of the stalk should be kept 3 or 4 inches from the top.

In less definite ways the general appearance of a field will show the experienced farmer that the plants are not in vigorous growth, and such impressions may be confirmed by examination of the soil. If the soil in the upper 2 feet is dry in appearance and will not hold its shape when squeezed by the hand, it is generally time to irrigate.

Wilting is permitted by some growers of Upland cotton who believe that it is advisable to check the development of the plants, since an excessive growth may cover the field with a dense canopy of foliage and greatly restrict the production of a crop. The growing of Upland cotton on very fertile soils is rather a hazardous undertaking.

After an irrigation any depressions that hold water should be drained. Standing water is not only bad for the cotton but injures the land. Some farmers reduce their yields materially by giving excessive irrigation on heavy land and allowing the excess water to stand in their fields.

IRRIGATION IN THE PICKING SEASON

Serious damage may result from withholding water too soon in the fall. It is often desirable to irrigate once after the first picking, and sometimes twice. Though vigorous growth of the plants is not desirable after the first of September and less water is needed as the days shorten and the weather becomes cooler, enough water should be used to keep the plants in a healthy condition and to take full advantage of favorable weather for maturing as many bolls as possible. Undoubtedly a lack of water may force an earlier opening of some of the bolls, but any severe check that wilts the leaves and forces the bolls to open prematurely is likely to be very injurious, especially if the growing season continues into October or November, as often occurs in the southwestern valleys.

The fact that picking may be advanced somewhat by withholding water is not a sufficient reason for checking the development of the crop at a period that may be most favorable for production. Even in relation to picking, nothing may be gained, for if the plants are checked and wilted many of the bolls are poorly developed and fail to open normally, so that picking becomes more difficult and the fiber is inferior.

Since the soils are seldom uniform, many fields contain spots where the plants need water, although a general irrigation may not be necessary in the latter part of the season. By throwing a ridge across the field and turning a small head of water down between the rows the spot that is drying out may be irrigated without wetting the rest of the field. Of course, such attention to the needs of the crop entails a little extra care and expense, but the increased yield and more uniform quality will more than offset the additional cost.

As the soil and climatic conditions govern to a large extent the number of irrigations to be given during the growing season, they also determine how late water should be applied. If the fall is cool, the bolls that are set after the middle of September are likely to be killed by frost. The period of boll development early in the season is only about 50 days, from the flower to the open boll, whereas later in the season the period of development is gradually lengthened to 70 or 80 days. If the soil is heavy and the cotton has grown very rank, special caution may be needed to avoid an excess of moisture late in the season, since the bolls are slow to open while the cotton is in a state of vegetative vigor. Also the bolls near the ground are likely to mildew or rot under a heavy growth of leaves.

PICKING

Cotton differs from many farm products in being less perishable and not requiring to be harvested immediately, as soon as the bolls open. (Fig. 6.) However, to get the best results picking should begin just as soon as enough cotton is open to be worth while for the pickers, which with Pima cotton is when there are 8 to 10 open bolls per foot of row. In the earlier fields picking begins about the middle of September, but many late-planted fields are not ready to pick until the middle of October.

To get the highest grades three pickings should be made and each picking kept separate, since marked differences may be found when the grading is carefully done. The later pickings usually con-



FIG. 6.—Normally developed and productive Pima plants at the end of the season

tain more broken leaves and other particles of trash, which tend to lower the grade. Also the first or the last picking may contain damaged or immature fiber which is weak and of inferior grade. Cotton from frost-killed bolls should never be mixed or ginned with the earlier pickings.

Light frosts may occur that kill the leaves but do not freeze or damage the bolls. Such frosts may serve a useful purpose, especially in rank cotton with dense foliage. After the leaves are frosted the fields dry out and the bolls open.

After a freeze that kills the bolls the fields should be gone over as soon as possible to gather the cotton from the bolls already open, before the damaged bolls have opened. If the stained and damaged fiber is picked with the good cotton all of the late picking must be sold as a lower grade, which may be a serious loss.

Cotton which has suffered severely for the lack of water or is otherwise damaged should also be picked and ginned separately, to avoid injuring the grade of the general crop.

To command the best price, careful picking is necessary to keep the cotton clean. This is especially true of Pima Egyptian cotton, and pickers who have handled only short-staple varieties may object at first to the care that is necessary to keep the Pima cotton clean. But after a little experience they find that it is not difficult to keep out most of the broken leaves and bracts.

Cotton should not be piled on the ground or left exposed in the field but housed or covered in a dry place. A little rain while the cotton is still in the bolls does little damage, but a heavy rain on a pile of cotton may result in staining and seriously injuring the grade. The dust and soil discolor the wet cotton so that it may be stained several inches deep. Cotton should not be picked when wet; if slightly damp it should be spread in the sun to dry. If thoroughly dry, seed cotton can be stored indefinitely without danger of heating.

GINNING

Roller ginning is necessary for Pima cotton. The process is slower and more expensive than saw ginning but is essential to marketing the lint as a superior long-staple cotton. One of the difficulties now recognized in connection with Pima cotton is that different equipment and methods of handling the cotton have been followed in the various ginning establishments, so that the commercial samples and bales have not had a uniform appearance. This undoubtedly has interfered with the marketing of the cotton to the best advantage.²

Care is needed by the ginner to avoid rolling and tangling the cotton, which makes it "rough" or "ropy" in the sample. Pima cotton should not be run through more than one set of "picker roll cleaners" and the "cleaner feeder." For cleanly picked cotton only the feeder cleaner is needed.

The gin stands should be kept in repair and adjustment, to turn out a uniform product. Loose machinery that cracks seeds or allows ginned seeds or unginned seed cotton to become mixed with the lint will lower the commercial grade and reduce the price to the farmer.

The bales should be completely covered with heavy burlap bearing the necessary label, and an adequate sample should be taken from each bale before it goes to the press, so that buyers will not have to cut the bales to establish their grade and staple.

² Willis, H. H. Utilization of Pima cotton. U. S. Dept. Agr. Bul. 1184, 26 p., illus. 1923.

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