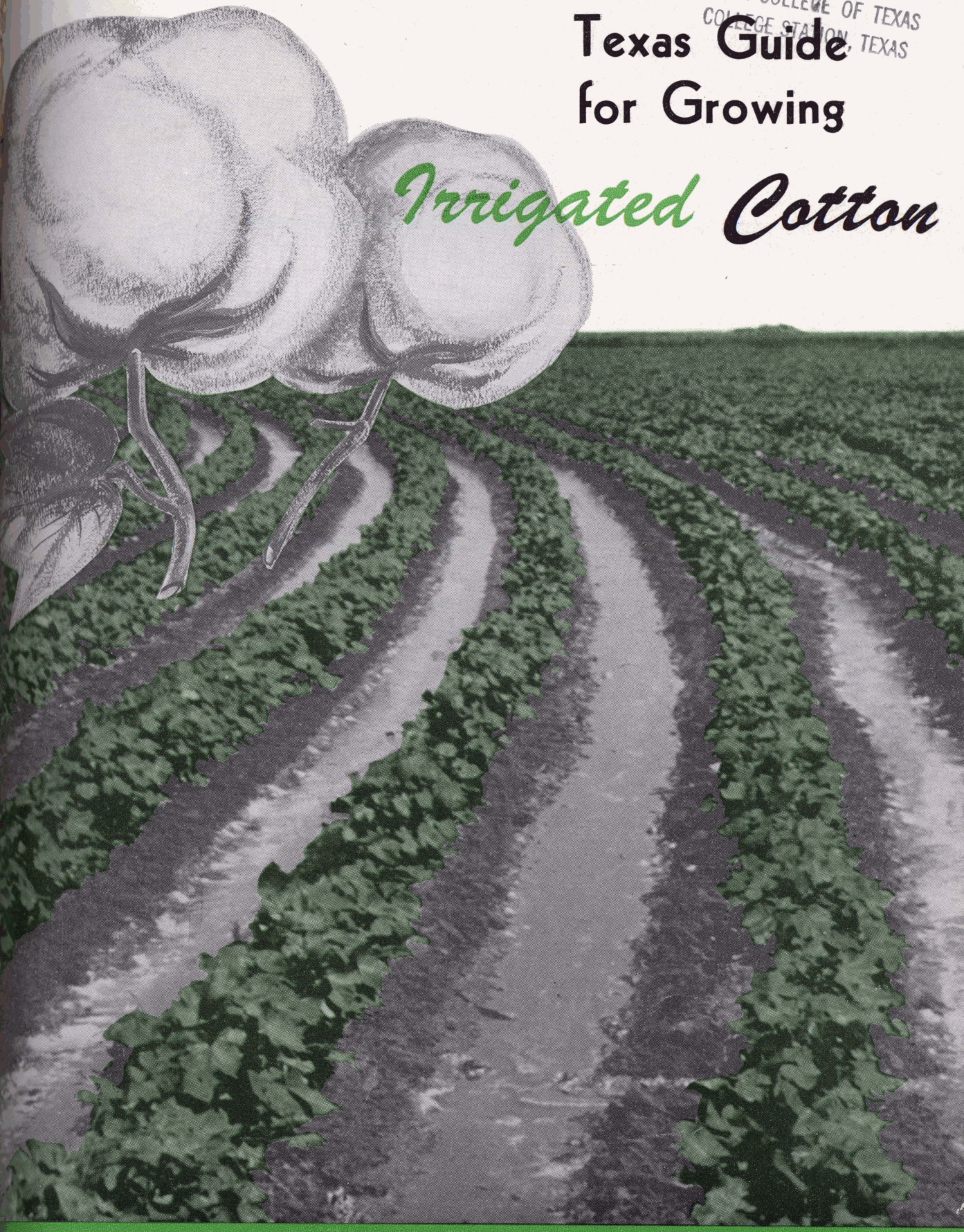
Texas Guide for Growing *Irrigated Cotton*



TEXAS AGRICULTURAL EXTENSION SERVICE
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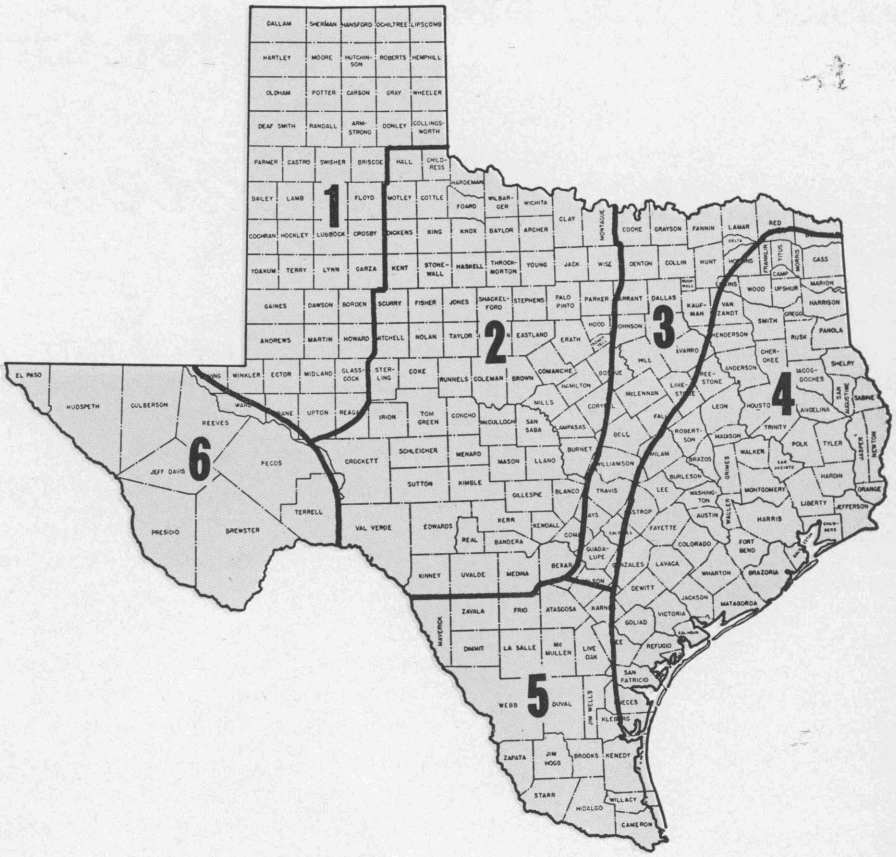
IRRIGATED COTTON AREAS OF TEXAS



	Irrigated Cotton Areas					
	1	2	3	4	5	6
Optimum planting period	May 10-May 20	May 5-May 15	May 1-May 10	April 10-April 20	March 5-March 15	April 10-April 20
Optimum seeding rate lb/acre	28-32	28-32	28-32	32-40	32-40	40-55
Period of most effective fruiting based on normal conditions	July 15-Aug. 25	July 10-Aug. 30	July 5-Aug. 30	June 10-July 30	May 20-July 15	June 15-July 30
Period of peak water use based on normal conditions	July 20-Aug. 30	July 15-Sept. 5	July 10-Sept. 5	June 15-Aug. 15	May 25-Aug. 1	June 20-Aug. 15
Minimum water requirement GPM/acre (1)	6.7	6.7	6.7	6.7	8.1	8.1
Shut-off date assuming normal weather conditions	Aug. 15-Aug. 25	Aug. 15-Sept. 1	Aug. 15-Sept. 1	Aug. 10-Aug. 20	July 25-Aug. 10	Sept. 1-Sept. 15
Daily water use during peak water use period (inches)	.25 - .35	.25 - .35	.25 - .35	.25 - .35	.30 - .40	.30 - .40

(1) Based on continuous flow required per acre at 70 percent application efficiency.

Texas Guide For Growing **IRRIGATED COTTON**

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THE SUCCESSFUL COTTON PRODUCER consistently attains high yields with low per unit production costs. To reach high production, all the factors which influence producton must be balanced. Water is only one factor which must be managed properly if production is to be maximum. Cotton plants need a continuous supply of available moisture throughout the growing period. Rainfall may provide a portion of the needed moisture, but moisture deficiencies can be overcome through irrigation. The time and amount of irrigation water to be applied will vary with the location and soil type within the State. This guide points out periods of peak water use and information on other production factors important to producing cotton efficiently under irrigation.

Water Supply

The available water supply should be enough to provide adequate moisture to meet cotton plant demands during the growing season. Table 1 on page 2 gives the minimum water requirements for cotton in the various areas of the State. This information is based on a 24-hour day operation and 70 percent application efficiency. If water is conveyed in earthen ditches, more will be needed to offset ditch seepage and evaporation losses. Minimum requirements should be raised if 70 percent application efficiency cannot be obtained.

Water for irrigation may be obtained from wells, lakes, ponds, streams or rivers. In some areas of Texas sufficient water supplies can be obtained from wells. Wells in dependable water formations provide a good source; however, the pumping expense could be great. Water stored underground is not subject to evaporation, and can be obtained at any time by merely starting the pump.

To obtain water from streams, rivers, lakes or ponds, the farmer should have a legal right to use such water for irrigation purposes. The dependability of water supplies from such sources during the season and from year to year is often variable. During hot weather when water requirements for cotton are high, stream flows are generally low. In the central and eastern portion of the State, water stored in lakes and ponds may provide a source of supply. Lakes or ponds used to supply irrigation water should have a storage capacity of 1½ to 2 acre-feet of water for each acre to be irrigated.

The quality of the water used for irrigation is important. If water of poor quality is used, harmful salts may accumulate in the soil thus ruining the land for crop production. All irrigation waters contain some salts. To determine the suitability of water for irrigation purposes, consider (1) the type and amounts of salt present, (2) the amount of water applied each year, (3) type of crop to be grown, (4) the amount of annual rainfall and (5) the type of soil and drainage characteristics. The quality of water in streams may vary. During periods of low flow, the water may be of poorer quality than during periods of high flow. Local county agents can advise farmers where to send water samples for chemical analysis and recommendations for suitability of use.

Varieties

Any cotton variety can be grown under irrigation. However, some are better adapted than others. In the old established irrigated areas, the varieties adapted to irrigation have been fairly well established but in the newer areas, particularly in the medium to heavy rainfall zones where irrigation is a supplementary practice, the adaptation of varieties has not been well established.

High yields often determine which varieties are recommended for a particular locality; however this factor should not be the sole or overriding consideration. Others such as (1) fiber properties, (2) boll and plant charac-

TABLE 1. COTTON VARIETY PERFORMANCE TESTS.

Variety	Boll type	Variety test results by areas (1) 1	2	3*	4	5	6	Length in 32's	Percent first harvest	Percent lint	Bolls per pound	Grade
Macha No. 1	Storm Proof	596						30	71.0	33.0		M
Paymaster 101	"	656	554					29	80.0	35.0	74	M
Western S.P.	"	678	482	312			1156	30	64.0	35.0	60	M+
Gregg	"	742						32	94.0	37.0	81	M
C A 119	"	628	503	270				31	67.0	34.0	77	M+
Blightmaster	"	655	414	400				31	65.0	33.0	77	M+
Lockett SP 1	"	636	487	314	488			30	67.5	34.0	81	M+
Dunn 7	Resistant	697		361				29	67.0	33.0		M
Stormking	"				494			31	84.0	35.0	76	M+
Lankart 57	"	650	697	362	633		1057	31	66.0	36.0	60	M
Lockett 140	"	611	565	302	525			29	70.5	34.5	75	M
Northern Star	"	607	573	314	541	1286		32	65.6	35.0	66	M
Paymaster 54	Open	646	672	347	588			30	84.0	34.5	73	M
Hibred	"	609						26	76.0	36.0		M+
DPL-TPSA	"	647	519	312	708	1379	1197	32	64.0	36.5	76	M–
DPL-15	"				343	537	1360	34	60.0	38.0	76	M–
DPL-Fox	"				425	618	1286	34	66.0	36.0	80	M
Kasch LL7	"		601	340				30	71.0	35.0	67	M+
Floyd 8G	"		475	287	461			31	57.0	34.0	58	M+
Plains	"					1393		34	56.0	35.0	68	M
Stoneville 2B	"			340	571	1343		34	63.0	34.0	67	M
Rowden 17 B	"	548	432	294	470			31	69.0	35.0	67	M
Coker 100 Wilt	Long			308	560	1443		35	59.0	35.0	70	M–
Stoneville 7	staple			285	524	1407		34	56.0	37.0	78	M–
Stoneville 3202	"				436	1394		34	76.0	37.0	77	M–
Delfos 1956	"				582	1357		36	63.0	35.0	69	M–
Acala 1517 C	"	615		307	490	1281	1032	36	63.5	34.0	67	M–
Empire, Watson	"	678	491	353	446	1250	885	33	66.0	35.0	62	M–
Texacala 5455	"	601	581	340	564	1304		33	71.3	36.5	73	M
Bobshaw 1A	"				507	1314		34	75.0	35.0	77	M
Dixie King	"				428	1324		34	66.0	36.0	60	M–
Acala 1517 BR	"						1018	37	76.0	37.0	66	M+
Acala 545C	"						1196	38	76.0	38.0	64	M+
C 261	"						1196	38	72.0	37.0	68	M+
C 108	"						1213	37	56.0	36.0	58	M+
Earlistaple	"						939	37	76.0	35.0	71	M+
Staham 898	"						1209	40	76.0	37.0	60	M+
Mesilla Valley	"						1027	42	70.0	33.0	67	M+
Pima S-1	Extra long staple						741	42	71.4	34.7	105	

*Nonirrigated
Based on variety tests conducted by the Texas Agricultural Experiment Station. For further information see Bulletin 877, "Performance of Cotton Varieties in Texas."

teristics, (3) local harvesting and ginning methods, (4) seed sources and (5) local preference should be taken into account.

Varieties should be selected on a basis of known performance in the area where they are to be grown. Varieties which do well in the Lower Rio Grande Valley may not live up to expectations on the High Plains. The producer should study current research findings and consult his county agricultural agent about new varieties.

Planting Dates

Under dry land conditions, the grower must plant when moisture conditions are most favorable and cannot be sure that this condition will coincide with the optimum date. With irrigation, however, moisture conditions can be controlled and the optimum planting date can be followed more closely.

Cotton is a hot weather plant and should be planted only after certain minimum soil temperatures have been attained. For best results, the minimum soil temperature at a depth of 8 inches should not be lower than 60 degrees F. during any 24-hour period, for 10 days preceding planting. This condition generally will not be met until near late February in the Lower Rio Grande Valley and early May on the High Plains.

Cotton planted 30 days in advance of the optimum planting date for a given area will not

necessarily permit harvest 30 days earlier. In most cases such a margin will be reduced by one half to two-thirds by harvest time. Planting too early seldom justifies the risk involved in having the seed and young plants exposed for longer periods to natural hazards, such as rain, hail, cold, disease and insects.

In areas where stalk disposal deadlines must be met to comply with Pink Bollworm Control Regulations, cotton must be planted in ample time to mature before the deadline date.

Seeding

Cotton can be planted various ways. The seed should be placed in direct contact with warm, moist, firm soil. Press wheels are used in many areas to assure this direct contact. Covering to a depth of 1½ to 2 inches gives best results. Deep covering of 3 to 4 inches should be avoided since it weakens the young seedling during its long period of emergence.

TABLE 2. COTTONSEED REQUIRED TO GIVE DESIRED PLANT SPACING IN 40-INCH ROWS.

Plant spacing in inches	Plants per foot of row	Plants per acre	Pounds of seed per acre[1]
1	12	156,816	58.0
2	6	78,403	29.0
3	4	52,272	19.4
4	3	39,204	14.5
6	2	26,136	9.7
8	1½	19,602	7.3

[1]Assume 4,500 seed per pound and 60 percent emergence.

Cotton can compensate to some degree for variation in stand. Best results are obtained from a planting rate of 24 to 32 pounds per acre; however, comparable yields will be obtained from planting rates which vary from 8 to 40 pounds of seed per acre. This optimum rate applies to all types of seed. Where acid-delinted seed are used, the poundage may be reduced *by not more than 10 percent.* Acid-delinted seed normally germinate and emerge more quickly than other types, but for seed of equal quality and under favorable conditions there should be no difference when planted at the same rate. The quantity of cotton seed required to give desired plant spacing in 40-inch rows assuming 60 percent emergence is shown in Table 2.

The use of mechanized equipment demands a regular and uniform stand for best results. Poor and uneven stands obtained by faulty planting methods can cause inefficient operation throughout the entire season.

Fertility Requirements

Cotton is a soil-depleting crop. Where grown continuously under irrigation, it gradually reduces the fertility level of the soil. The cotton plant does not feed as heavily on soil nutrients as do other row crops, but the tillage practices which go with cotton production offer little opportunity for the return of residues or organic material to the soil. When cotton is grown in a cropping sequence that allows for the regular addition of active organic residues of high quality, it will produce high yields with less fertilizer than cotton grown continuously on soil that becomes low in organic matter. The lint and seed in one bale of cotton removes approximately 35 pounds of nitrogen, 15 pounds of available phosphoric acid and 15 pounds of potash from the land on which it is produced. When the burs are removed, these quantities are greater. The seed contain the bulk of the minerals which are removed. In addition to the nutrients contained in the lint and seed, the soil also must supply mineral nutrients in amounts which will support a vigorous plant with a healthy root system and a leaf structure which is capable of producting high lint yields.

The cotton plant utilizes two-thirds of its total uptake of nutrients during the first one-third of its life cycle. It is important that an adequate supply of plant food be available the first 55 to 65 days after emergence. This period covers the life of the plant into the early boll stage.

For each bale of cotton produced, the soil must furnish the following amounts of plant foods: nitrogen, 80-100 pounds; phosphorous, 40-60 pounds; potash, 60-90 pounds. The actual amount of fertilizer applied in each case should be based upon the results of a soil analysis and the recommendation of the local county agent.

Cotton burs can provide organic matter to improve the fertility and physical condition of the soil. The value of applying cotton burs to land is shown in Table 3.

One of the most practical methods of using burs to improve the soil is to apply 2 to 4 tons

TABLE 3. COTTON BUR TEST, 1953-1956, LUBBOCK, TEXAS*

Rate ton/acre	Yield, lint pounds/acre	Pounds lint per acre-inch water
0	502	22.8
2	612	27.8
4	652	29.6
6	727	33.0

*Addition of 30 pounds and 45 pounds of nitrogen to 4 tons of burs increased lint yield average by 87 pounds and 211 pounds respectively in 1956. Rainfall 9.5 inches, irrigation 16.0 inches, total 25.5 inches in 1956.

per acre per year of dry burs directly from the gin.

Application and Placement Of Fertilizers

Fertilizers should be applied at or near planting time. In areas of high rainfall there is a possibility of loss due to leaching if application is made too far in advance of planting. Where local conditions permit the nitrogen and potash may be split into two applications. The nitrogen may be placed one-third to one-half at time of planting and one-half to two-thirds as a sidedressing within 30 to 40 days. In some areas potash behaves in an erratic manner. Best results are obtained by making two applications of that element, putting one-half down at or near planting and one-half as a sidedressing 4 to 6 weeks later. Placement studies show that best yields result from the placement of the fertilizer in bands 2 to 4 inches to the side and 2 to 4 inches below the seed. Seed placed in contact with nitrogen or potash materials will be reduced seriously in germination percentages. Sources of plant food elements make little difference in final yields if supplied in adequate amounts and proper ratios. Cotton can utilize both the ammonium and nitrate forms of nitrogen. Fertilizer should be purchased on the basis of cost per unit of plant food instead of on a basis of price per ton. There is no set procedure for the fertilization of cotton. Each location presents a different problem. It is recommended that each farmer make limited fertilizer tests on his farm.

Weed Control

Irrigation magnifies the weed and grass problem. Cultivation is the primary control.

Do not use cultivating equipment when soil is too wet.

Cultivate just deep enough and often enough to control weeds. Most annual weeds and grasses come up in the top ½ inch of the soil.

Proper use of the rotary hoe is effective in early weed control and will help considerably in reducing the hoe bill.

Uniform row spacing (preferably 40-inch row width) is of utmost importance and allows precision operation of all equipment.

If chemicals are used in early weed control, use only on a small acreage until experience is gained. Pre-emergence materials perform more satisfactorily where cotton is planted on beds or on the level than where planted in the furrow. Avoid use on deep sands. Follow the manufacturer's instructions on the label.

Post-emergence use of herbicidal oils or lateral oiling of grass and weeds in young cotton is recommended where cotton is planted on the bed or on the level on all types of soils.

Johnsongrass is more persistent under irrigation and seedling grass is more difficult to control. Spot treatment of Johnsongrass with herbicidal oils and solutions of sodium dalapon and sodium TCA in water are chemical sprays commonly used. See Bulletin 808, "Spot-Oiling Johnsongrass."

Diuron (at ¾ to 1¼ lb. per acre in 30 to 40 gal. of water) may be used to control seedling weeds and grasses in irrigated cotton at lay-by time provided a winter crop is not to follow on the same land. Crops may be planted in the spring following treatment. Apply immediately before or after the last cultivation, provided such cultivation after application does not disturb more than the top inch of soil. Light cultivation following treatment is desirable only when the ground is not wet thoroughly across the row during irrigation. Irrigate field 1 week after application. For best results, irrigation should thoroughly wet the surface of the ground to carry the chemical into the root zone of germinating weeds. Apply the material in a spray suspension directed so as to cover the soil uniformly beneath cotton plants and between rows, avoiding contact with cotton plants. See label on the package for detailed instructions.

Flame cultivation in irrigated areas is becoming more popular.

The grass and weed infestation of the cotton crop before the young plants emerge can be reduced by pre-emergence flaming. When the cotton plant has reached a height of about 8 inches or a diameter of 3/16 inch, it will tolerate the heat of flame cultivation. At this stage cotton may be flamed for the first time. Flamings may be repeated at intervals of 7 to 10 days, or as often as necessary to control weeds and grasses as they emerge. To control late weeds and vines, flamings should continue even after regular cultivating is suspended. This will result in a cleaner crop at harvest and keep weeds from going to seed.

Diseases and Insects

The problem of cotton diseases and insects is magnified under irrigation. Where no control measures are taken, serious damage will result. Diseases such as bacterial blight, verticillium wilt, cotton root rot and certain seedling diseases are the worst offenders.

Blight can be controlled to a degree by planting resistant varieties. Few wilt-resistant varieties are known at this time. Clean seed of high quality and rotation with nonsusceptible crops such as small grain will help. On badly infected land, this is not sufficient to keep down the diseases and organisms which live in the soil.

The latest recommendations for insect control can be obtained from your local county agent.

Defoliation

Chemical defoliation, when used properly, is a valuable asset to the cotton producer. When improperly used, it can reduce yield and damage fiber properties. At least 60 percent of the bolls should be open when true defoliation or dessicants are applied. Under certain conditions where cotton is rank, application of a chemical which will remove the leaves and allow the sun and air to get to the bolls may reduce boll rot. This method, however has certain disadvantages because once the leaf is destroyed all plant functions decrease and boll and fiber development are checked at the time of application. If a very high percentage of the bolls are immature, the resulting harvest of lint may be of lower grade.

The producer should weigh carefully the economic advantages and disadvantages of chemical defoliation before undertaking an extensive defoliation program. L-145 "Cotton Defoliation Guide" gives a list of materials and recommendations for their use in Texas.

Harvesting

The cotton producer must turn more to mechanization in an effort to lower production costs and to make more efficient use of his land, labor and capital. Under irrigation, many cotton varieties do not lend themselves to mechanical harvesting methods because of excessive height, limby growth, too long a fruiting period and lodging. Open boll types of 1 inch and longer in staple length lend themselves to harvest with the spindle picker in South Texas along the Gulf Coast, in the river bottoms and in the Pecos and El Paso valleys. The storm-resistant boll types lend themselves to the stripper on the High Plains, Rolling Plains and Uplands of Central Texas.

Cotton Growth Pattern

The pattern that the cotton plant follows in its growth habits is shown below. Variety differences and varying climatic conditions under which cotton is grown in Texas account for the upper and lower time limits. This information applies only to cotton crops which are developing normally and are not beset by outside influences, such as insects, diseases, drouth or nutrient deficiency.

	Av.	No.	days
1. From planting to emergence	7	to	10
2. From emergence to square	35	to	40
3. From square to white bloom	20	to	25
4. From white bloom to open boll	50	to	65
5. From bloom to full-grown boll	20	to	25
6. Average number of days to peak blooming		90	
7. Average number of days from first bloom to peak blooming (Approximately 35 to 40 percent of blooms make bolls.)		35	
8. Boll period	45	to	65
9. Fiber length laid down first	25	to	30
10. Critical period in fiber length (Available soil moisture is the limiting factor in determining length of lint in a given variety.)	16	to	20 (after blooming)
11. Strength of fiber determined second	25	to	30 (of boll development)

	Av. No. days		
12. Time required to produce normal crop	140	to	160
13. From first white bloom until 70 percent of crop is open	85	to	95
14. From first white bloom until 85 percent of crop is open	95	to	105

Fiber Quality

Staple length phase of fiber growth begins the day the bloom opens and pollination takes place. A cotton fiber is a thin-walled, hollow, tubular structure which first elongates for a period of 13 to 20 days. Then the primary fiber wall is strengthened and thickened by cellulose being deposited on its inner surface for a period of 25 to 40 days.

Each lint fiber on the seed elongates for a period of 13 to 20 days, depending on the variety and on growth conditions. The fiber elongates slowly for about 5 days, more rapidly the sixth to the fourteenth day, and then slowly until it ceases.

Length of the fiber is influenced to some extent by moisture factors, particularly those which bring about water stress within the plant. When water stress is severe the plants wilt.

Even before wilting occurs, water stress slows down the growth of the entire plant. A slowing down in the rate of fiber elongation during this 13 to 20 day period results in the production of short fiber.

Secondary cell wall thickening of the fiber in most varieties takes place within 25 to 40 days. It may continue over a longer period for long-staple cotton. Research shows that this secondary wall structure of the fiber is one of the key factors in a cotton's spinning performance. Therefore, proper amounts of moisture should be available to the plant during this period.

Water Use and Plant Development

The rate of water used by the cotton plant will vary throughout the growing season. Adequate soil moisture is required to germinate the seed. From the time the seed sprouts, and for the first few weeks after emergence, the rate of water used by the plant is low. The loss of soil moisture by evaporation during this period may exceed the amount of water transpired by the plant.

The first fruiting forms appear about 4 weeks after emergence. In an additional 3 to 3½ weeks, these forms will produce blooms. During this period, the rate of water use increases steadily, but probably will not exceed .1 inch per day. As the first blooms appear, there is a sharp increase in the rate of soil moisture use. The cotton plant reaches its peak water use rate during the early blooming stage and continues throughout the boll development period. The rate of water used by the plant during this critical period of development may range from .25 to .4 inches of water per day depending on weather conditions. The rate begins to decline when most of the bolls are fully developed. This decrease continues until plant growth has ceased.

On page 11 is illustrated the general pattern of the rate of water use by cotton throughout its growth period.

The cotton plant obtains water through its roots which are in contact with available soil moisture. For normal plant growth and development, most of the plant roots must be in contact with a readily available supply of soil moisture at all times. Movement of soil moisture after the free water has drained away is slow. Because of this slow rate of movement, plant roots must grow to the moist soil. Plant roots will not grow into a dry soil.

After the cotton seed germinates, the root system develops rapidly. The first to form is the tap root, with a few lateral branches. The early rooting system penetrates only a small percentage of soil and if the soil moisture is depleted from around the limited root system, plant growth is retarded.

As the plant grows, the lateral roots spread out through a large part of the soil. When mature, the roots normally will be fairly well distributed through the soil. In deep soils, cotton roots may penetrate 5 to 6 feet.

Root growth may be limited by hard pans, heavy clays, plow sole, high water table, dry soil, regions of high salt content and nematodes. Too much cultivation or working the soil when it is too wet will compact the soil so that both water penteration and root development will be limited.

When to Irrigate

During the growing season, cotton should be irrigated just before the root zone of the soil no longer contains sufficient moisture to supply the needs of the plant for proper development. From a practical standpoint, the irrigator cannot wait until the soil moisture content reaches this point on an entire field. Irrigation should begin when about half the moisture in the root zone has been depleted. This will provide sufficient time to cover a large acreage before the available soil moisture on the last portion of the field has been depleted.

By inspecting soil moisture conditions at regular intervals and at several depths, the irrigator obtains information on the rate moisture is being used by the cotton plant from the different soil depths. This provides a basis for determining when and how much water to apply.

To estimate the available soil moisture, squeeze a small amount of soil in the hand to form a ball; then study the feel chart (Table 5, page 10) for estimating soil moisture for a description of the feel and appearance of different textured soils for various moisture percentages.

The illustration on page 11 indicates that the period of peak water use begins with blooming and continues throughout the boll development period. The irrigator should maintain adequate soil moisture during this period so that a maximum amount of early fruit can be set. The highest quality fiber develops from the forms which appear early in the life of the plant.

If conditions permit, ample soil moisture should be stored to depths of 3 to 5 feet in the soil before planting. If rainfall does not provide this needed moisture, a preplanting irrigation will be necessary. This deep moisture stored before planting will provide a portion of the moisture needed during the period of peak water use and permit lighter applications later in the season.

The number of irrigations required during the season will be governed primarily by the amount and distribution of rainfall, summer temperatures and soil type. Sandy soils have a lower storage capacity for water per foot of depth than clays; consequently they require more frequent and lighter applications. Table 4 gives water-holding capacity of various textured soils per foot of depth.

To meet the plants' demands for water during the peak use period, an adequate supply of water to wet the soil to a 3 foot depth every 6 to 10 days for sands, and 10 to 14 days for clay soils, will be needed.

TABLE 4. WATER HOLDING CAPACITY OF DIFFERENT TEXTURED SOILS.

Soil texture	Available water—in. per ft. of depth
Sandy (coarse)	½ — 1
Sandy loams (light)	1 — 1 ½
Silt and clay loams (medium)	1½ — 2
Clays (heavy)	2 — 2 ½

Irrigations applied late in the season delay maturity. In most cotton-producing areas of Texas with the exception of the Pecos and El Paso areas, irrigation after the middle or last of August may prove of little value.

An exteremely high level of soil moisture may encourage excessive vegetative growth at the expense of boll set. This condition seems to exist under a high nitrogen level. During late fruiting periods, it is probably advisable to time applications to allow available soil moisture to reach a lower level than during early fruiting period. This will help prevent reduced yields caused by excessive vegetative growth and delayed maturity. If the soil moisture becomes too low and extensive wilting occurs, the next irrigation may cause the plant to shed many of its young squares and bolls resulting in a loss in yield.

Cotton plants can forecast their need for irrigation. After flowering begins, the plant should grow steadily but not luxuriantly. The squares at the top of the plant should be rather prominent. A few flowers should be visible among the top leaves. When only the leaves are noticeable, too rapid a growth is being made and water possibly should be restricted. A flower garden effect, just the opposite, indicates that growth is restricted and irrigation has been delayed too long.

Color of plant leaves and terminal growth may indicate the need for irrigation. A change in the appearance of the plant foliage occurs before signs of wilting appear. The foliage of plants in dry spots will appear somewhat

darker with a slightly bluish tinge. When the plant is in thriving condition, there ordnarily will be 3 to 4 inches of tender, light-green stems between the terminal bud and the reddish coloring of the stalk. A rapid extension of this reddish coloring toward the terminal bud shows a checking of growth and need for irrigation.

Soil moisture conditions, appearance of the plant, and the stage of its development are useful guides in determining when to irrigate and how much to apply. A reminder: If the beginning of irrigation is delayed too long, much of the acreage may undergo severe wilting before irrigation is completed on the entire acreage.

TABLE 5. FEEL CHART FOR ESTIMATING SOIL MOISTURE

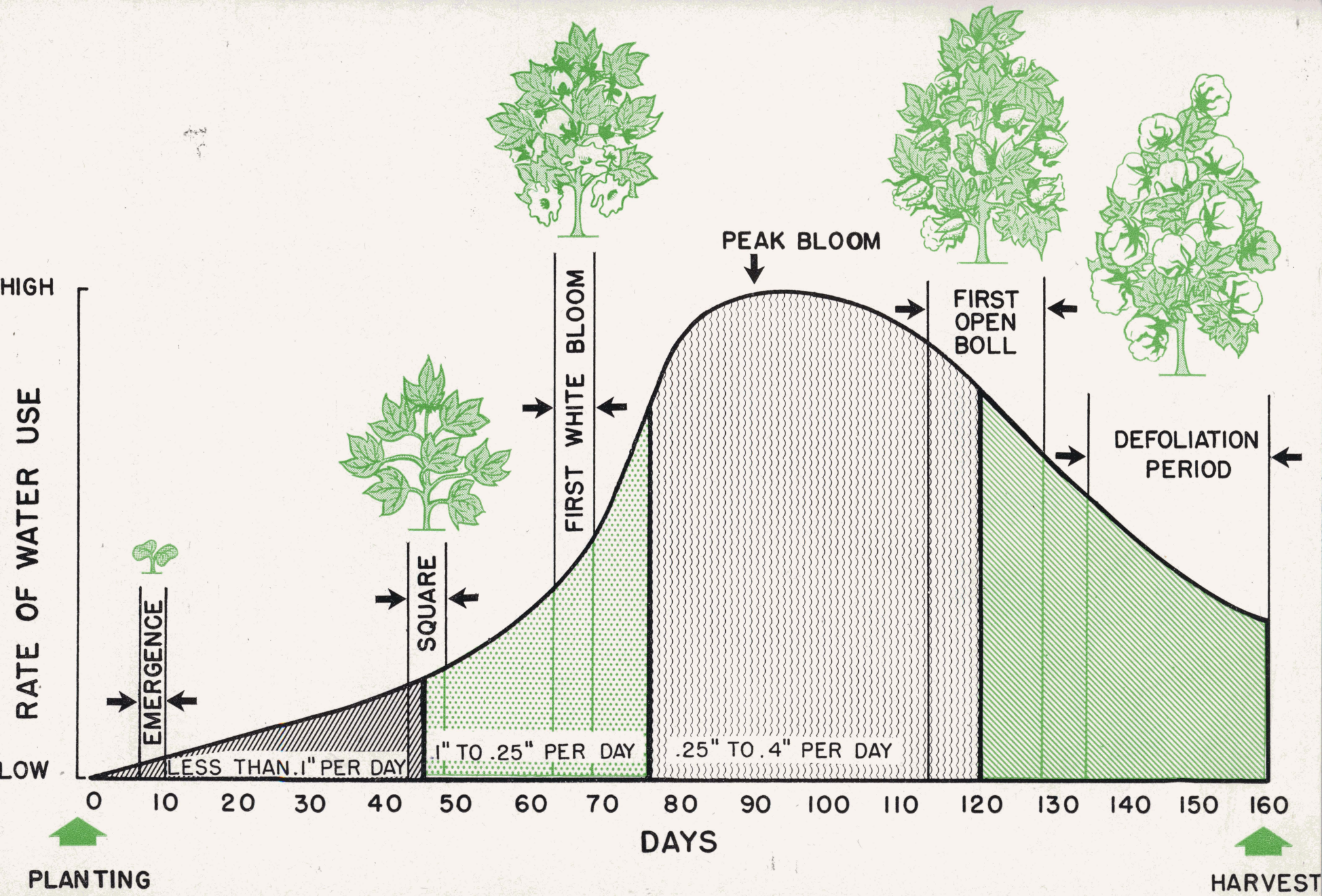
Degree of Moisture	Percent useful Soil Moisture Remaining	Feel Or Appearance Of Soils			
		Coarse	Light	Medium	Heavy-Very Heavy
Dry	0	Dry, loose, single-grained, flows through fingers.	Dry, loose, flows through fingers.	Powdery, dry, sometimes slightly crusted but easily breaks down into powdery condition.	Hard, baked, cracked; sometimes has loose crumbs on surface.
Low	50 or less	Still appears to be dry; will not form a ball with pressure.*	Still appears to be dry will not form a ball.*	Somewhat crumbly, but will hold together from pressure.*	Somewhat pliable; will ball under pressure.*
Fair	50 to 75	Same as coarse texture under 50 or less.	Tends to ball under pressure but seldom will hold together.	Forms a ball, somewhat plastic; will sometimes slick slightly with pressure.	Forms a ball; will ribbon out between thumb and forefinger.
Excellent	75 to field capacity	Tends to stick together slightly; sometimes forms a very weak ball under pressure.	Forms weak ball, breaks easily, will not slick.	Forms a ball and is very pliable; slicks readily if relatively high in clay.	Easily ribbons out between fingers, has a slick feeling.
Ideal	At field capacity	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.	Same as coarse.	Same as coarse.	Same as coarse.
Too wet	Above field capacity	Free water appears when soil is bounced in hand.	Free water will be released with kneading.	Can squeeze out free water.	Puddles and free water forms on surface.

*Ball is formed by squeezing a handful of soil very firmly with fingers.

Ideal

Too Dry

Rate of Water Use in Relation to Plant Development



How Much Water ARE YOU USING?

TABLE 6. DEPTH OF WATER IN INCHES, APPLIED TO VARIOUS NUMBER OF ACRES, IN 1 HOUR IF SPREAD UNIFORMILY

Gallons per minute	Acre inches per hour or cubic feet per second	Acres Irrigated Per Set					
		½	1	1½	2	2½	3
100	.22	0.44	0.22	0.15	0.11	0.09	0.07
150	.33	.66	.33	.22	.17	.13	.11
200	.45	.90	.45	.30	.23	.18	.15
250	.56	1.12	.56	.37	.28	.22	.19
300	.67	1.34	.67	.45	.34	.27	.22
350	.78	1.56	.78	.52	.39	.31	.26
400	.89	1.78	.89	.59	.45	.36	.30
450	1.00	2.00	1.00	.67	.50	.40	.33
500	1.12	2.24	1.12	.75	.56	.45	.37
550	1.23	2.46	1.23	.82	.62	.49	.41
600	1.34	2.68	1.34	.89	.67	.54	.45
650	1.45	2.90	1.45	.97	.73	.58	.48
700	1.56	3.12	1.56	1.04	.78	.62	.52
750	1.67	3.34	1.67	1.10	.84	.67	.56
800	1.79	3.58	1.79	1.19	.90	.71	.59
850	1.90	3.80	1.90	1.27	.95	.76	.63
900	2.01	4.02	2.01	1.34	1.01	.80	.67
950	2.12	4.24	2.12	1.41	1.06	.85	.70
1000	2.23	4.46	2.23	1.49	1.12	.89	.74
1200	2.68	5.36	2.68	1.79	1.34	1.09	.89
1400	3.12	6.24	3.12	2.08	1.56	1.25	1.04
1600	3.57	7.14	3.57	2.38	1.79	1.43	1.19

Example

An irrigation farmer has a water supply of 600 gallons per minute which is being used to irrigate 20 rows, having a 40-inch spacing, ¼ mile long (1,320 feet) in one set.

How many inches of water will be applied in 1 hour?

How many hours will be required to apply 4 inches of water per set?

$$\text{Number of acres per set} = \frac{20 \text{ rows} \times \frac{40}{12} \times 1320}{43{,}560} = 2.0 \text{ acres}$$

With the number of acres per set known, refer to 600 under the column "gallons per minute" and across to 2 under "acres," and read .67 inch. This means that 600 G.P.M. running for 1 hour, if spread uniformly will cover 2 acres to a depth of .67 inch.

$$\text{Then } \frac{4 \text{ inches}}{.67 \text{ inches per hour}} = 6 \text{ hours - - - time required to apply 4 inches of water to 20 rows 1,320 feet long}$$

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