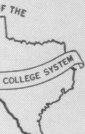


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SPOT-SPRAYING JOHNSONGRASS



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Summary

Grazing, mowing, tillage, cultivation, rotary weeding, hand hoeing and various combinations of these practices can be used for mass control of Johnsongrass in fields. Pre-emergence chemical treatments, lateral applications of chemicals and flaming are used for this purpose in some areas but are not suited to many Texas conditions. Mass methods are effective for reducing Johnsongrass stands but ordinarily do not get rid of this grass. However, the old grass in most Texas row crops can be eradicated in one season by consistent use of cultural methods supplemented by spot-spraying.

Herbicidal oils and water solutions of sodium dalapon, sodium TCA and maleic hydrazide are some of the sprays used for spot-treating Johnsongrass. Oils are commonly applied to the crown. Water solutions are applied as wetting sprays to either the foliage or the soil or both. These and other sprays suitable for spot-treating Johnsongrass must be applied selectively if the crop plants in the treated spots are to be saved.

A half-and-half mixture of naphtha and diesel fuel oil is the oil spray most generally used. Various other oil mixtures may be used for economy, for increased contact toxicity, or for a combination of contact toxicity and residual effectiveness. Oil sprays kill on contact and are most effective when applied to the crown of Johnsongrass sprouts 6 inches or less in height.

Sodium dalapon is used at the concentration of 20 pounds in 100 gallons of water. It is a translocated herbicide but also has a residual effect. Sodium dalapon kills the tops of the grass and many underground buds. Previously, it was used primarily for nonselective treatment of large spots of Johnsongrass in sparsely infested cotton fields and for treatment of noncrop sites. A new sprayer developed at College Station now permits selective use of this herbicide in cotton and sorghum.

Sodium TCA at a concentration of 50 pounds in 100 gallons of water is used for controlling Johnsongrass spots in noncrop sites and in fields during noncrop periods. A mixture of 40 pounds of sodium TCA and 20 pounds of sodium dalapon can be used for spot-treating sparsely infested cotton fields. It is a knock-out spray under some conditions.

Maleic hydrazide (MH-30) is a translocated growth inhibitor with no residual. It is used as a wetting spray to the foliage at a concentration of 2½ gallons in 100 gallons of water for preplanting treatment of established Johnsongrass spots before any spring crop when no residual can be tolerated. Subsequent killing of the affected tops eradicates the grass.

A man on foot using a hand sprayer does the best and safest job of spot-spraying Johnsongrass in crops. The Texas Agricultural Experiment Station has developed three excellent hand sprayers for this purpose: the Texas Gravity Sprayer, the Texas Jetgun and the Texas Slidegun. The first two sprayers are for close work when Johnsongrass infestations are interspersed between crop plants. The Slidegun is for rapid spraying in fields when it is more economical to kill the crop plants in the treated spot than to save them. Texas Blade, a combination weeder and shield, also has been developed for shielding a crop plant while making a close application of spray with a Jetgun.

Cover Picture

The 1955 cotton crop in two fields is shown in this picture. Both had a similar infestation of Johnsongrass sprouts early in 1954. Spot-spraying eradicated the grass in cotton in the upper field in 1954. The grass in the lower field was hoed both years.

Spot-spraying Johnsongrass

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JOHNSONGRASS (*SORGHUM HALEPENSE*) is an aggressive perennial which infests over 5,000,000 acres of cropland in Texas. Farmers long have used grazing, mowing, tillage, cultivation, rotary weeding and hoeing for the mass control of this grass. Some of them have tried, but usually have not accepted, pre-emergence chemical treatments, lateral application of chemicals and flaming for this purpose. These methods are effective for reducing Johnsongrass stands when they are used persistently.

Spot-spraying was introduced by the Texas Agricultural Experiment Station in 1954. This practice was immediately popular as a supplement to cultural practices for the control of Johnsongrass, particularly for scattered infestations in cotton. Spot-spraying was used on 89,491 acres of infested cotton land in 133 Texas counties in 1956. Subsequent progress by the Texas Station has increased the efficiency of the spot-spraying practice and extended its use.

Development of Johnsongrass

Density of stand, intensity of light, temperature, humidity, length of day and soil conditions such as texture, tilth, fertility and moisture influence the growth of Johnsongrass. Although frost kills the tops, this grass spreads rapidly from seed and rootstocks. New Johnsongrass plants arising from rootstocks are called sprouts to distinguish them from seedlings.

JOHNSONGRASS SEEDLINGS

Johnsongrass seedlings emerge throughout the growing season and are the primary source of new infestations. The seed germinate under a wide range of conditions and seedlings emerge from a depth of 2 inches or more in the soil. Seed remain viable in the soil for long periods, but under Texas conditions, most of them germinate within 3 years after they are produced.

Seedlings first have a single erect stem. However, several buds soon start growing from the crown and a clump is formed in a short time. Killing the top of a Johnsongrass seedling without destroying the crown greatly stimulates the production of secondary stems.

Some of the buds from the crown make underground growth and start rootstock formation early. As a root-

stock grows, it forms nodes or joints at intervals of 3 inches or less. These nodes may bear a bud which can emerge at any time. Each new stem forms its own crown and is capable of independent development. Rootstock development usually is well advanced by the time a seedling reaches the boot stage. The seedling may be 6 weeks old and up to 30 inches tall by that time. Flowering and seed production follow rapidly.

JOHNSONGRASS SPROUTS

Johnsongrass propagates itself vegetatively by means of rootstocks. Any detached or intact rootstock that remains in moist soil survives and can produce one or more sprouts either during the current season or the next. Ordinarily rootstocks do not survive to the third year. Johnsongrass sprouts emerge sooner in the spring and grow more vigorously than seedlings. Otherwise, their development is similar to that of a secondary stem of a seedling.

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Effect of Farming Practices

Close and continuous grazing of Johnsongrass reduces seed production, depletes seed stocks in the soil, causes shallow rootstock formation and reduces stand.

Frequent mowing has some of the same effects as grazing but is less effective in depleting stands of the grass.

Tillage depletes Johnsongrass stands to the extent that seedlings and sprouts are uprooted regularly and rootstocks are desiccated. Johnsongrass has a remarkable capacity to recuperate. Sharp tools set at the

TABLE 1. CONTACT SPRAYS FOR SPOT-TREATING ESTABLISHED JOHNSONGRASS IN CROPS

Sprays	Additions to 100 gallons and effectiveness	Approximate cost of mixture per gallon, dollars
For contact killing of Johnsongrass sprouts		
Naphtha ¹	None. Toxicity greater than needed for crown-oiling 6-inch sprouts under most conditions.	0.23
Diesel fuel oil ¹ or kerosene ¹	None. Toxicity low. Reliable for crown-oiling 6-inch sprouts only during hot weather. Use diesel and kerosene interchangeably in mixed sprays.	0.13
1/2 naphtha 1/2 diesel	None. Reliable for crown-oiling 6-inch sprouts under most conditions.	0.18
C-56 in kerosene	C-56 (hexachlorocyclopentadiene) ² increases penetration of plant tissue. 1 qt. C-56. Toxicity equal to 1/2 naphtha and 1/2 diesel for crown-oiling 6-inch sprouts.	0.17
	2 qt. C-56. Reliable for basal oiling of lower 8 inches of stems in boot stage.	0.21
	4 qt. C-56. Useful for oiling 8-inch stubs of Johnsongrass in flowering stage.	0.29
Dinitro in kerosene	1 qt. oil soluble dinitro ³ (Dow General or others). Toxicity equal to 1/2 naphtha and 1/2 diesel for crown-oiling 6-inch sprouts.	0.16
Pentachlorophenol in kerosene	4 gal. pentachlorophenol (44 percent). ⁴ Toxicity equal to 1/2 naphtha and 1/2 diesel for crown-oiling 6-inch sprouts.	0.19
C-56 + dinitro in kerosene	1 gal. C-56, 1 pt. dinitro. Toxicity superior to equivalent concentration of C-56 in kerosene.	0.31
C-56 + pentachlorophenol in kerosene	1 gal. C-56, 4 gal. pentachlorophenol (44 percent). Toxicity and penetration equivalent to C-56 + dinitro in kerosene.	0.37

¹Bulk oil dealers.

²Hooker Electrochemical Co., Niagara Falls, N.Y.

³Dow Chemical Co., Houston, Texas; or Southwest Sprayer & Chemical Company, Waco, Texas.

⁴Local lumber yards.



Figure 1. Large spots with dense stands occur within a season or two unless Johnsongrass infestations are eradicated promptly.

proper depth and operated to overlap are needed to uproot all the Johnsongrass. Repeated summer tillage to kill this grass before it is 10 inches tall reduces stands and sometimes eradicates it. Ordinary seedbed preparations for most crops retard the spread of Johnsongrass but do not reduce stands greatly.

Good drainage is essential for timely use of cultural practices in row crops. Uniform row spacing, cleaning the bed at planting and good crop stands help control Johnsongrass.

Pre-emergence chemical treatments sometimes control shallow emerging Johnsongrass seedlings but are not reliable under many Texas conditions.

Rotary weeding under suitable soil-crusting conditions is an inexpensive method of materially reducing the stand of Johnsongrass seedlings shortly after they emerge in cotton, corn and sorghum.

Lateral oiling kills Johnsongrass seedlings less than 2 inches tall and can be used safely in cotton 3 to 10 inches tall (prior to bark formation) if surface conditions along the row are suitable for operating oiling equipment.

This practice is not compatible with planting cotton in a furrow or with bed planting and cultivating practices used in Texas. Some farmers in the State use lateral oiling on an emergency basis when early rains level the beds. Beds can be leveled by early rotary hoeing. Rains thereafter smooth them satisfactorily for the use of oiling equipment.

Timely sweep cultivation cuts or uproots Johnsongrass in the middles and covers small seedlings in the row. Covering the seedlings before crown formation or uprooting them prior to rootstock formation destroys them. Cutting older seedlings and sprouts only retards

their growth. Dull and improperly set sweeps, carelessness in guiding a cultivator and the occurrence of wide middles reduce the efficiency of cultivation.

The efficiency of hand hoeing for the control of Johnsongrass depends on how it is done. All seedlings must be cut below the crown before rootstocks are formed. Sprouts should be cut off before they make crowns. Old clumps of the grass should be dug up.

Flaming and lateral application of suitable water-soluble herbicides kill Johnsongrass seedlings less than 1 inch and can be used safely in cotton after bark is formed (stems larger than a pencil). However, these practices require a level bed and are not compatible with the Texas cultivation practice of dirtting cotton.

Shading, particularly in cotton, is effective for controlling late germinating Johnsongrass seedlings.

The use of supplementary irrigation greatly complicates the control of Johnsongrass in row crops. Irrigation practices that cause crops to lodge are objectionable.

Early harvest and prompt preparation of the soil help control Johnsongrass.

Methods used for growing cotton in Texas retard the spread of Johnsongrass and sometimes eradicate it. Those used for growing corn favor the spread of Johnsongrass and most other weeds. Stands of this grass increase in sorghum but less rapidly in forage sorghum than in grain sorghum. Johnsongrass stands usually increase in cool season cereal crops, but their early harvest permits subsequent use of intense summer tillage. Alfalfa and other closely mowed or grazed crops grown for 3 or more consecutive years deplete Johnsongrass seed stocks in the soil.

Chemicals for Spot-spraying

Spot-spraying is an effective and convenient method for killing Johnsongrass sprouts and seedlings that otherwise are neglected in row crops. Herbicidal oils and water solutions of sodium dalapon, sodium TCA and maleic hydrazide are some of the sprays used for this purpose. Tables 1 and 2 give some spray mixtures that can be used under various conditions. These and other sprays available for spot-treating Johnsongrass must be applied selectively. Crop plants in the treated spots are severely stunted or killed if they are sprayed.

Herbicidal oils are commonly applied to the crowns of Johnsongrass sprouts.¹ Water solutions are applied as wetting sprays to either the foliage or the soil or both. The addition of 2 to 4 pounds of Fab or other wetting agents per 100 gallons of water usually improves the effectiveness of coarse foliage sprays.

HERBICIDAL OILS

Most petroleum products that flow are called oils. Gasoline, naphtha, kerosene and diesel fuel oil flow freely and are widely available. Gasoline ignites too easily for safe use in spraying weeds and is too expensive. Naphtha,

TABLE 2. SYSTEMIC AND RESIDUAL SPRAYS FOR SPOT-TREATING ESTABLISHED JOHNSONGRASS IN CROPS

Sprays	Additions to 100 gallons and effectiveness	Approximate cost of mixture per gallon, dollars
For contact and systemic killing of Johnsongrass by crown or basal application in cotton or sorghum		
HCA in kerosene	3 gal. HCA (90 percent hexachloroacetone). ¹ Contact toxicity equals 1/2 naphtha and 1/2 diesel. Residual effectiveness during rainy months similar to equivalent concentration of TCA in water.	0.35
For systemic killing of Johnsongrass by foliage application		
Dalapon in water	10 lb. sodium dalapon. ² 4 lb. Fab ³ or equivalent wetting agent. For cheap selective spraying of terminal foliage of 3-leaf sprouts under humid conditions.	0.13
	20 lb. sodium dalapon, 4 lb. Fab or equivalent wetting agent. Most reliable treatment for vigorously growing foliage of Johnsongrass of varying ages.	0.23
For systemic killing of Johnsongrass by temporary soil sterilization		
TCA in water	50 lb. sodium TCA. ⁴ For fall application prior to cotton for 80 percent or more reduction in stand of established Johnsongrass without subsequent effects on cotton.	0.20
HCA in kerosene	See above.	
For potential knockout of sparse infestations by nonselective spot applications		
TCA-dalapon mixture in water	40 lb. sodium TCA, 20 lb. sodium dalapon, 4 lb. Fab or equivalent wetting agent. For foliage and soil application in cotton and sorghum. Kills crop in treated spots.	0.43
HCA in kerosene	See above.	
For spring preplanting spot-spraying before any row crop		
Maleic hydrazide in water	2 1/2 gal. maleic hydrazide (MH-30). ⁵ Stops growth of grass including underground buds. Destruction of affected tops eradicates or nearly eradicates the grass.	0.44

¹General Chemical Div., Allied Chemical & Dye Corp., Houston, Texas.

²Dow Chemical Co., Houston, Texas; or Southwest Sprayer & Chemical Company, Waco, Texas.

³Local grocery store.

⁴Dow, DuPont or Orchard Brand Dealers, or Southwest Sprayer & Chemical Company, Waco, Texas.

⁵Naugatuck Chemical Co., Bethany, Connecticut.

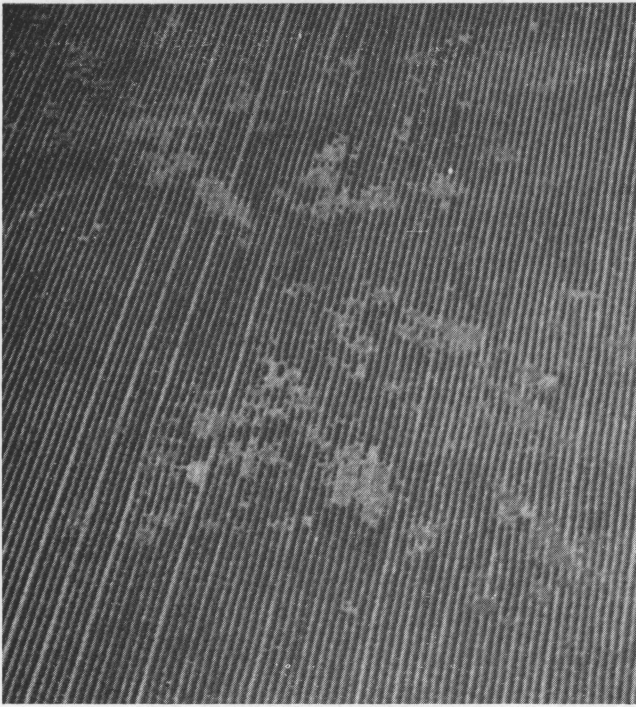


Figure 2. This is an aerial view of a row-crop field with a sparse infestation of large Johnsongrass spots. Use nonselective spot-application of a systemic or residual herbicide to eradicate them rapidly.

kerosene and diesel fuel oil are used alone and in mixtures in various weed sprays. They are contact herbicides and have no systemic or residual effects.

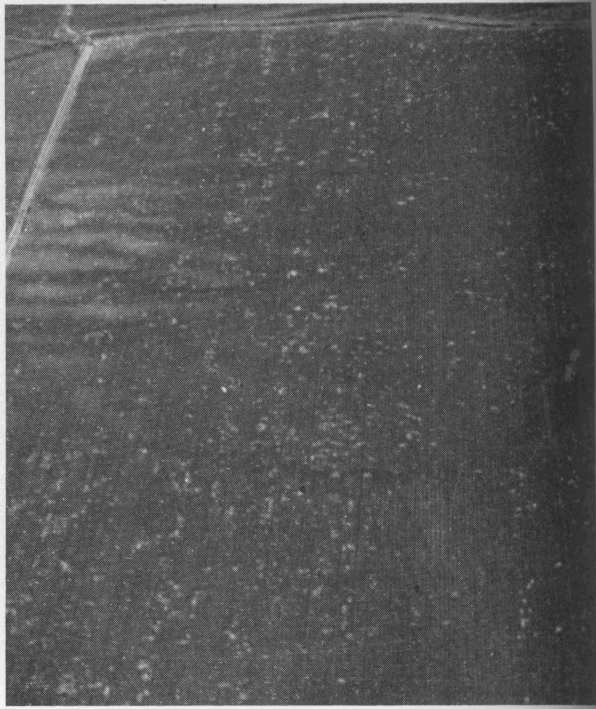


Figure 4. The white spots in this aerial picture are small clumps of Johnsongrass. Use selective spot-spraying to supplement cultural practices for their eradication in any row crop.

Naphtha is the name for a group of oils commonly used for cleaning clothes and thinning paint. Most naphthas are more toxic than necessary for use in crown-

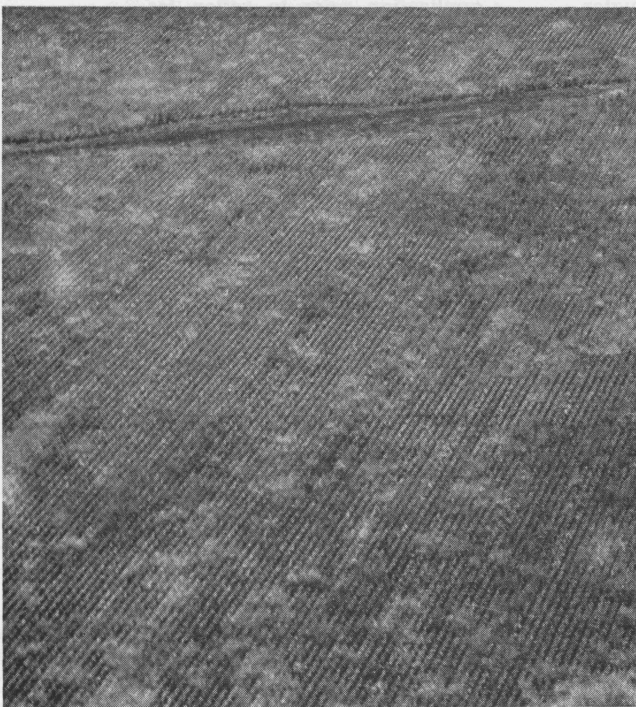


Figure 3. This is about a 25 percent infestation of Johnsongrass. Such infestations can be spot-sprayed safely in cotton and corn with a Texas Jetgun.

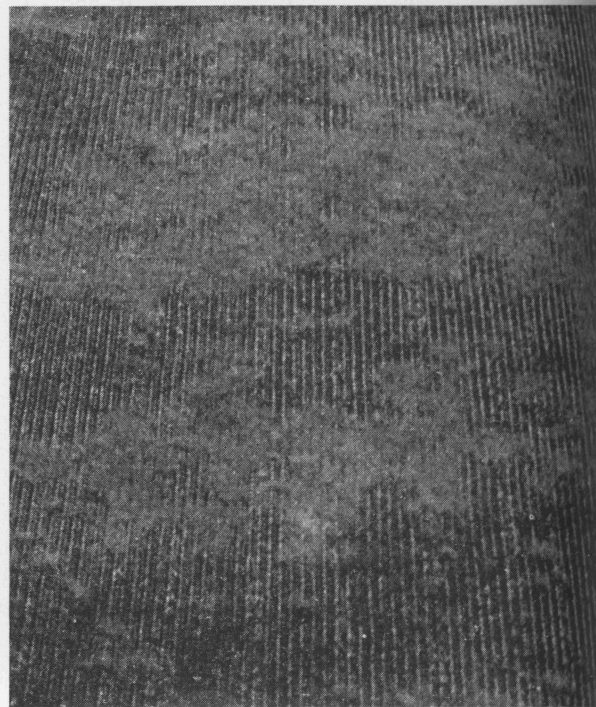


Figure 5. This is about a 50 percent infestation of Johnsongrass. Spot-spraying eradicated such an infestation in irrigated cotton at College Station.

oiling tender Johnsongrass sprouts and can be diluted with cheaper and less toxic oils such as kerosene and diesel fuel oil. A mixture of one-half naphtha and one-half diesel fuel oil (or kerosene) is a reliable spray for crown-oiling 6-inch Johnsongrass sprouts under a wide range of weather conditions.

Kerosene and diesel fuel oil are the cheapest oils available to Texas farmers and can be used interchangeably in most weed-spraying mixtures. Ordinarily, their toxicity is too low for crown-oiling Johnsongrass sprouts except during hot weather. However, various chemicals can be added to these oils to increase their effectiveness. Several kerosene sprays containing either C-56 (hexachlorocyclopentadiene), oil-soluble dinitro, pentachlorophenol or HCA (hexachloroacetone) are listed in Tables 1 and 2.

C-56 is a wax solvent and increases the penetration of plant tissue by oil sprays. Additional information about C-56 is given in Texas Agricultural Experiment Station Progress Report 1995. Oil-soluble dinitro and pentachlorophenol are strong contact herbicides. They increase the efficiency of oil sprays for killing plants. HCA is a systemic herbicide with residual effectiveness.

Crown-oiling a 6-inch Johnsongrass sprout with naphtha or a similar oil spray induces wilting within 3 hours in strong sunlight and causes lodging and browning within 24 hours. The oil soaks through the stem and kills the crown. Also, some of the oil seeps to the rootstocks and may kill them to a depth of several inches. New sprouts soon emerge from rootstocks remaining alive. Repetition of the crown-oiling practice to kill them at about 10-day intervals eradicates established Johnsongrass after four to six treatments.

Crown-oiling tender sprouts when they are about 6 inches tall is always more efficient than treating older grass, and is safer in crops. Treating older grass should be confined to emergencies. As the grass approaches the boot stage of growth the lower portions of the stems become glazed and resistant to ordinary oils. About that time it is advisable to add C-56 to an oil spray. Concentrations of C-56 to use for treating Johnsongrass in varying stages of growth are given in Table 1.

HCA can be added to an oil spray to obtain prompt contact killing of Johnsongrass sprouts followed by possible eradication after one to three treatments. Rain within 2 weeks after treatment usually is required for maximum residual effectiveness of HCA. Under favorable conditions a single treatment may eradicate the grass but frequently three treatments are required. Ordinarily such a spray should be used only for nonselective treatment of sparse infestations of large spots in crops or for selective application in infested cotton and sparsely infested sorghum.

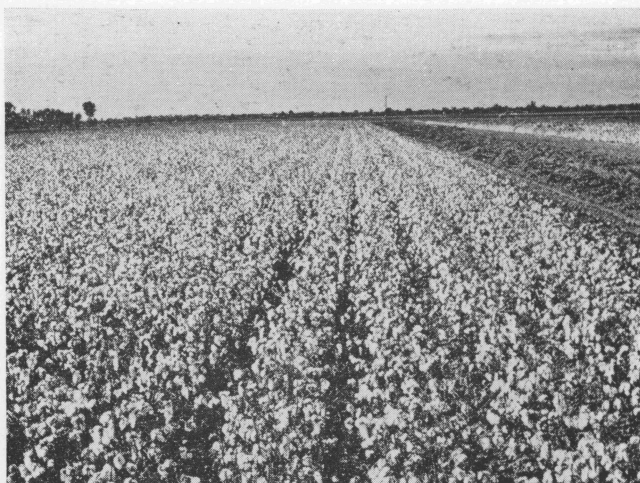


Figure 6. This field was abandoned to a severe infestation of Johnsongrass for 10 years prior to growing this crop of dryland cotton in 1955. Spot-spraying before and after the cotton was planted eradicated the Johnsongrass while 1½ bales of cotton an acre were being produced. Subsequent control of Johnsongrass seedlings has kept this field clean.

WATER-SOLUBLE HERBICIDES

Sodium Dalapon

Sodium dalapon, a water-soluble salt, is primarily a grass killer but stunts or kills most crop plants. Treating the foliage of Johnsongrass sprouts with a spray containing 20 pounds of sodium dalapon in 100 gallons of water usually kills the sprouts and most of the underground buds. Two to four treatments of new sprouts usually are required to eradicate the grass. This concentration of the spray has been reliable for the treatment of vigorously growing Johnsongrass at College Station for several years. Also, a spray containing 10 pounds of this herbicide in 100 gallons of water has been



Figure 7. Effectiveness of spot-oiling for control of Johnsongrass is shown by the treated area at right as opposed to the check plot, which received normal hoeing, at left.



Figure 8. A Texas Slidegun is being used here for non-selective spraying of a spot of Johnsongrass.



Figure 9. Two nonselective applications of sodium dalapon nearly eradicated this spot of Johnsongrass. The first application killed the cotton in the spot. An additional treatment was needed to eradicate the grass.



Figure 10. Use selective spot-spraying to save all the crop plants. Treat the foliage of three to five-leaf Johnsongrass sprouts when water sprays are used. Treat the crowns of 6-inch sprouts when oil is used.

effective when the terminal foliage of three to five-leaf Johnsongrass sprouts was treated.

Treatment of the tender foliage of Johnsongrass with a dalapon spray is followed by translocation of the chemical to underground buds. Buds nearest the crown and those least active are affected most. Those remote from the crown and those growing rapidly may survive. Partially affected sprouts are stunted and distorted. Prompt re-treatment kills them. Cutting them off stimulates resprouting.

Warm, moist conditions favor rapid growth of Johnsongrass sprouts and prompt translocation and high effectiveness of dalapon. These conditions prevail most frequently during April and May in Texas. Translocation of dalapon in Johnsongrass may occur in a few hours, but maximum translocation usually requires several days. Low temperatures, dry weather and slow growth of Johnsongrass delay and may prevent adequate translocation. Dalapon sprays are most effective early in the season and should be used only in infested cotton, in sparsely infested sorghum or in noncrop sites. They usually become progressively less effective at College Station as the summer advances. Dalapon seldom controls nearly mature grass.

Dalapon may have a temporary sterilizing effect in the soil and heavy spring applications before planting could reduce crop stands. Corn and sorghum are very susceptible to the soil effects of dalapon. Planting cotton should be delayed 30 days when rain occurs shortly after a preplanting application of dalapon. However, treating Johnsongrass sprouts the day before planting cotton at College Station reduced infestations 60 percent or more on several occasions without subsequent effect on the cotton. Also a heavy infestation of Johnsongrass sprouts in cotton at College Station was eradicated in 1957 by selective application of dalapon with only temporary stunting of an occasional cotton plant.

TCA Alone and in a Mixture

A solution of 50 pounds of sodium TCA, a dry salt, in 100 gallons of water applied as a wetting spray to Johnsongrass sprouts and the soil in the fall is effective and economical for controlling this grass in the humid portion of the State. The primary action of TCA is through the soil and the presence of the grass is immaterial except to outline the spots to be sprayed. The treated area should not be disturbed until after rain occurs to wash the TCA into the soil. This practice commonly has reduced the stand of established Johnsongrass 80 percent or more at College Station without affecting cotton planted the next spring. Crops other than cotton should not follow the fall use of TCA.

A mixture of 40 pounds of TCA and 20 pounds of dalapon in 100 gallons of water often is preferred to the

use of TCA alone or dalapon alone. It has been a reliable and versatile knockout spray for treating Johnsongrass at College Station for several years. Spring and summer use of the spray in crops must be limited to fields with infestations sparse enough to permit economic sacrifice of crop stands in the treated spots.

Maleic Hydrazide

Spraying Johnsongrass sprouts with a mixture of 2½ gallons of maleic hydrazide (liquid formulation) (MH-30) in 100 gallons of water stops the growth of the grass and most of the underground buds for about 10 days. By that time, the leaves have developed variegated red, purple and white splotches. Killing the tops of the grass promptly thereafter either by cultural or chemical means eradicates or nearly eradicates the grass. The factors influencing the effectiveness of maleic hydrazide are similar to those discussed for dalapon, but there are no aftereffects from the spring use of maleic hydrazide before planting any crop.

The maleic hydrazide method of controlling Johnsongrass sprouts has been used successfully at College Station in several fields during each of the past three seasons. Usually the old grass was eradicated prior to the emergence of late-planted crops such as sesame and guar. Ordinarily, stands were reduced 60 percent or more prior to the emergence of cotton.

Spot-sprayers

A man on foot using a hand sprayer does the best and safest job of spot-spraying Johnsongrass in row crops. Since most commercial hand sprayers are too fatiguing to carry and operate all day, the Texas Agricultural Experiment Station has developed three excellent lightweight, easy-to-operate hand sprayers for spot-treating this grass. They are the Texas Gravity Sprayer, the Texas Jetgun and the Texas Slidegun. Texas Blade, a combination weeder and plant shield, has been developed for use with the Jetgun.

The Gravity Sprayer and the Jetgun are for close work where the crop is to be saved. Johnsongrass sprouts are never too close to crop plants for safe treatment with a Jetgun when a Texas Blade is used as a plant shield. The Slidegun is for rapid spraying in fields where it is more economical to kill the crop in the treated spots than to save it. Also, the Slidegun is handy for treating non-crop sites when the use of a power sprayer is inconvenient. TAES Progress Report 1987 gives further information about these sprayers.

Various tractor and other power sprayers are efficient for continuous spraying both in and out of crops. Some of them can be adapted for spot-spraying.



Figure 11. The Johnsongrass sprouts in this cotton have been crown-oiled. The excess oil on the ground was wasted.

Cost of Spot-spraying

Spot-spraying is for cleanup purposes when established Johnsongrass in a field is to be eradicated. The cost of spot-spraying varies with the degree of infestation, the method used, the growth of the grass and seasonal weather conditions. Costs cited in this report are for controlling Johnsongrass on highly fertile soils of the Brazos River Valley near College Station, Texas.

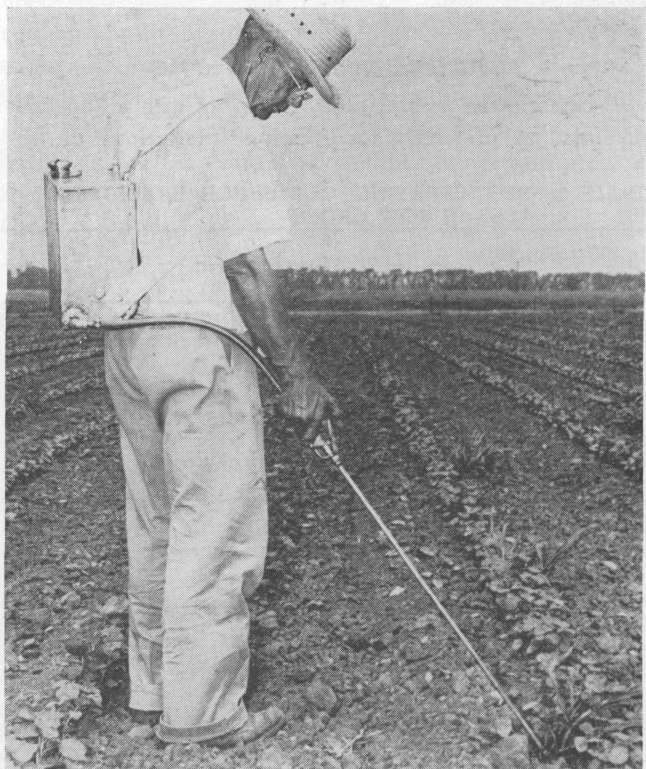


Figure 12. The Texas Gravity Sprayer is satisfactory for crown-oiling 6-inch Johnsongrass sprouts when infestations are moderate. This sprayer was new in 1954 and soon became popular.



Figure 13. Crown-oiling kills tender Johnsongrass sprouts to the ground within a few hours. Four to six crown-oilings of sprouts at about 10-day intervals exhaust Johnsongrass rootstocks. Two of the sprouts in this clump were untreated.

Fields are classified on the basis of the row footage occupied by Johnsongrass. An infestation is designated as 100 percent when the entire row footage in a field has to be treated to kill the sprouts by nonselective spraying. A descriptive statement is used for experimental records to give information on the density and distribution of the grass and the contamination of the soil by Johnsongrass seed.

SPARSE INFESTATIONS

Nonselective application of a spray with a knockout potential is preferred for treating infestations of less



Figure 14. The Texas Blade and Texas Jetgun were new in 1957. A Jetgun is the most efficient sprayer to use for selective spot-application of any spray. The Blade is used to protect crop plants from the spray when necessary and to cut scattered tall weeds.

than 1 percent and for treating widely scattered large spots infesting 10 percent or less of the row footage in a field. Small clumps and sprouts interspersed between crop plants should be sprayed selectively. A large spot is one occupying a space of more than 2 feet in the row. The 10 percent limit on nonselective application is suggested as the maximum loss of crop stand that a farmer might tolerate to permit rapid spraying of large spots.

The sprays shown in Table 3 for nonselective application with a Slidegun are suitable for use in cotton and sorghum and are most effective under humid conditions.

TABLE 3. SPOT-SPRAYING COSTS FOR ERADICATING JOHNSONGRASS SPROUT INFESTATIONS OF 10 PERCENT OR LESS IN ROW CROPS

In 100 gallons of spray	Treat grass in	Apply to	Apply times	Apply with	Grass, inches tall	Cost an acre, dollars
Nonselective treatment						
Clump infestation under 1 percent and large spots up to 10 percent						
40 lb. TCA						
20 lb. dalapon	Cotton, sorghum	Foliage, soil	1-3	Slidegun	6-10	3-8
or 3 gal. HCA						
97 gal. kerosene	Cotton, sorghum	Foliage, soil	1-3	Slidegun	6-10	3-8
Selective treatment						
Clump infestation of 1 to 10 percent						
50 gal. naphtha						
50 gal. diesel	Row crops	Crown	4-6	Gravity Sprayer	6	8-17
50 gal. naphtha						
50 gal. diesel	Row crops	Crown	4-6	Jetgun	6	6-13
1/4 gal. C-56						
99 3/4 gal. kerosene	Row crops	Crown	4-6	Jetgun	6	6-13
20 lb. dalapon in water	Cotton, sorghum	Foliage	3-4	Jetgun	3	9-18
10 lb. dalapon in water	Cotton, sorghum	Foliage	3-5	Jetgun	3	6-12
3 gal. HCA						
97 gal. kerosene	Cotton, sorghum	Crown	3-4	Jetgun	6	9-18

They may eradicate the grass following a single treatment but usually two or three are needed.

Table 3 also gives information on the cost of several sprays for selectively treating Johnsongrass sprout infestations of 1 to 10 percent. Cost estimates given in this table are more reliable than those subsequently given for higher infestations.

Crown-oiling 6-inch Johnsongrass sprouts is safe in any row crop and is reliable anywhere in the State. A naphtha-diesel mixture applied with a Gravity Sprayer is used most commonly. This is mainly because these oils are widely available and many Texas farmers already have Gravity Sprayers. A quart of C-56 in 100 gallons of kerosene is as reliable as a naphtha-diesel mixture and is a little cheaper. Also, a Jetgun can be used more efficiently than a Gravity Sprayer.

Three gallons of HCA in 100 gallons of kerosene can be used to advantage for crown-oiling under humid conditions when early eradication of the grass following a few treatments is desired. HCA is a residual herbicide and should be used cautiously in severely infested cotton and moderately infested sorghum. Its use in other crops should be avoided until further research is done.

A Jetgun is most efficient for the selective application of water soluble herbicides such as sodium dalapon. Sprays containing this herbicide are most reliable under humid conditions and usually eradicate Johnsongrass faster than oil sprays devoid of HCA. However, they are more tedious to apply selectively and the 20-pound concentration generally recommended is a little expensive. The 10-pound concentration is cheap but might not eradicate Johnsongrass sprouts as fast as the higher concentration. Dalapon has a residual effect in the soil and should be used only in the crops specified. Its selective

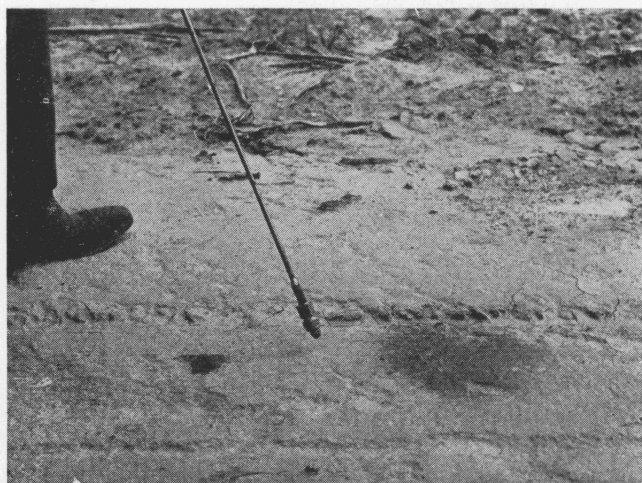


Figure 15. A small or a large target can be sprayed with a single shot from a Jetgun.

use in cotton is safe but it should be used cautiously in sorghum.

MODERATE INFESTATIONS

Information on the cost for spot-treating Johnsongrass infestations of 15 to 25 percent in a few fields at College Station in 1956 is given in Table 4. Costs cited do not include those for normal cultural practices or the use of pre-emergence and lay-by sprays. Cotton was hoed only when it was thinned. A Gravity Sprayer equipped with a special nozzle was used for selective application of dalapon in cotton and sorghum. Preplanting spot-treatment of Johnsongrass sprouts in the corn field was with a tractor. A pre-emergence and a lay-by treatment for the control of seedling weeds and grasses were used in corn and the corn was hoed once. A Gravity Sprayer was used for making all crown-oilings. An occasional cotton and corn plant were killed in spot-

TABLE 4. TREATMENTS AND COST PER ACRE FOR CONTROLLING JOHNSONGRASS INFESTATIONS OF 15 TO 25 PERCENT AT COLLEGE STATION IN 1956

Percent infestation	Crop	Treatments	Percent control	Cost an acre, dollars
15	Cotton	3 weekly applications of 10 lb. sodium dalapon in 100 gal. water plus a wetting agent to terminals of 3-leaf Johnsongrass sprouts followed by 4 crown-oilings with $\frac{1}{2}$ naphtha and $\frac{1}{2}$ diesel as needed for control of late seedlings.	100	10.63
15	Cotton	4 weekly crown-oilings of 3-leaf Johnsongrass sprouts with $\frac{1}{2}$ naphtha and $\frac{1}{2}$ diesel followed by 3 crown-oilings as needed for control of late seedlings.	100	10.58
19	Forage sorghum	1 application of 20 lb. sodium dalapon in 100 gal. water plus wetting agent and one with 10 lb. dalapon in 100 gal. plus wetting agent to terminals of 5-leaf Johnsongrass sprouts followed by 2 crown-oilings with $\frac{1}{2}$ naphtha and $\frac{1}{2}$ diesel as needed for control of late seedlings.	98	11.78
25	Corn	Preplanting spot-treatment of Johnsongrass sprouts with $1\frac{1}{4}$ gal. maleic hydrazide (MH-30) followed by 5 crown-oilings of 6-inch Johnsongrass in corn.	100	17.75



Figure 16. The right hand normally is used to operate the pump of a Jetgun and to aim the spray at the desired target. The Texas Blade is used in the left hand.

treating Johnsongrass in these crops. Also, minor reductions in the stand of sorghum were caused by the initial spot-application of dalapon in this crop.

HEAVY INFESTATIONS

Spot-spraying becomes increasingly expensive as Johnsongrass sprout infestations approach 50 percent. Ordinarily the use of cheap methods such as intensive tillage during noncrop periods should precede the use of spot-spraying for controlling such infestations. However, economic considerations often require the continuation of cotton production in highly fertile irrigated fields despite Johnsongrass infestations. In such a case spot-spraying should be started promptly. Some costs for eradicating a 50 percent infestation of Johnsongrass sprouts in irrigated cotton at College Station in 1957 and for controlling leftover seedlings until August 24 are given in Table 5.



Figure 17. A Texas Blade is used here to protect the stem of a cotton plant while a Johnsongrass sprout is being oiled with a Jetgun.

All sprays were applied with a Texas Jetgun and cotton plants were protected with a Texas Blade when necessary. Oil sprays were applied to the crowns of the grass and dalapon was applied to the terminal leaves. The stand of the grass was thick and the sprouts were 6 to 7 inches tall when spraying was started. The cotton was rotary hoed once and a normal cultivating schedule was used. All hand hoeing that contributed to the control of the grass was included in costs.

Spraying the grass prior to and shortly after the first cultivation was tedious but subsequent treatment of new sprouts was as fast as hoeing. An occasional cotton plant was killed by crown-oiling and a few were stunted by the dalapon spray. About the same volume per acre was required for each spray and one could be applied about as fast as the other. The cost per acre for treating the grass was lowest when the cheapest spray was used. HCA and dalapon sprays were more expensive than unfortified oil but eradicated the sprouts faster.

REINFESTATIONS

The risk of reinfestation must be considered in any spot-spraying program. Contamination of the soil, current seed production, and the introduction of new seed are major factors affecting reinfestation by Johnsongrass seedlings. Ordinarily, their stands are sparse in row crops preceded by 3 or more years of close mowing or grazing and by cotton that has been hoed closely for several seasons. However, stands increase rapidly in row crops neglected during any part of the growing season and effective control measures should be initiated at the first sign of possible reinfestation.

Recommendations

SPOT-TREATING JOHNSONGRASS

Use spot-spraying to supplement tillage, cultivation, hoeing and other mass practices for eradicating spotted infestations of established Johnsongrass, particularly in row crops. Treat any acreage for controlling infestations up to 10 percent. Treat limited to moderate acreages more heavily infested.

SPOT-SPRAYERS

Use a Texas Gravity Sprayer for crown-oiling up to 5 percent infestations of 6-inch Johnsongrass sprouts (from rootstocks) in cotton, corn, sorghum and most other row crops. Expect a few crop plants to be killed.

Use a Texas Jetgun for crown-oiling up to 50 percent infestations of 6-inch Johnsongrass sprouts in cotton, up to 25 percent infestations in corn and up to 10 percent infestations in sorghum. Use a Texas Blade to shield crop plants while making close applications to adjacent

Johnsongrass sprouts with a Jetgun. Expect to save all the cotton and corn but expect a few sorghum plants to be killed. Also, use a Jetgun for basal application of oil sprays for control of Johnsongrass sprouts more than 6 inches tall.

Use a Jetgun for making swirl (terminal leaves) applications of water sprays for the control of up to 50 percent infestations of three-leaf Johnsongrass sprouts in cotton and up to 10 percent infestations in sorghum. Use a Texas Blade to shield crop plants when necessary.

Use a Slidegun for rapid nonselective application of sprays with a knockout potential for controlling up to 10 percent infestations of large spots of Johnsongrass in cotton when it is more economical to kill the cotton plants in the treated spots than to save them. Also, use a Slidegun for treating spotted infestations in fields during noncrop periods and on noncrop sites.

TABLE 5. TREATMENTS AND COST PER ACRE FOR ERADICATING 50 PERCENT INFESTATION OF ESTABLISHED JOHNSONGRASS IN IRRIGATED COTTON AT COLLEGE STATION, 1957

Cultivation	Hoeing	Spray mixture used			Dollars ¹ per acre
		1/2 naphtha 1/2 diesel	20 pounds dalapon + 4 pounds Fab in 100 gallons water	3 gallons HCA 97 gallons kerosene	
1		6			17.75
1	1	5			20.50
1	3	2 ²			21.00
1	1	3 ²	3		22.50
1	1	3 ²		3	22.50
		7			24.80
		3	4		25.50

¹Include \$1.50 per acre for hoeing Johnsongrass seedlings on all areas on August 23. Considerable reinfestation by Johnsongrass seedling occurred thereafter.
²For late season control of Johnsongrass sprouts and seedling.

SPRAYS FOR SPOT-APPLICATION

Use a mixture of one-half naphtha and one-half diesel fuel oil or a mixture of one-quarter of C-56 (hexachlorocyclopentadiene) in 100 gallons of kerosene or other oils with similar contact toxicity for crown-oiling 6-inch Johnsongrass sprouts. Expect to use 4 to 6 applications at intervals of about 10 days for eradication of sprouts and seasonal control of scattered Johnsongrass seedlings.

Use 2 to 4 quarts of C-56 in 100 gallons of kerosene for basal spraying of Johnsongrass sprouts more than 6 inches tall. Spray the lower 8 inches of the sprouts approaching boot stage. Use the higher concentration



Figure 18. Selective spot-spraying with a Jetgun was used to eradicate a severe infestation of Johnsongrass sprouts in this irrigated cotton field in 1957. Half of the row footage in the field was as severely infested as is shown here.

of C-56, hack off the stems and treat 8-inch stubs of grass in the bloom stage.

Use 3 gallons of HCA (90 percent hexachloroacetone) in 100 gallons of kerosene or other suitable oils for combined contact and residual effectiveness in controlling Johnsongrass sprouts in cotton and on noncrop sites. Use HCA fortified oil only during months when rain of 1 inch or more can be expected within 2 weeks after application. Expect cotton stands to be killed in thickly infested spots unless a Texas Blade is used to shield crop plants while using a Texas Jetgun to make close application.

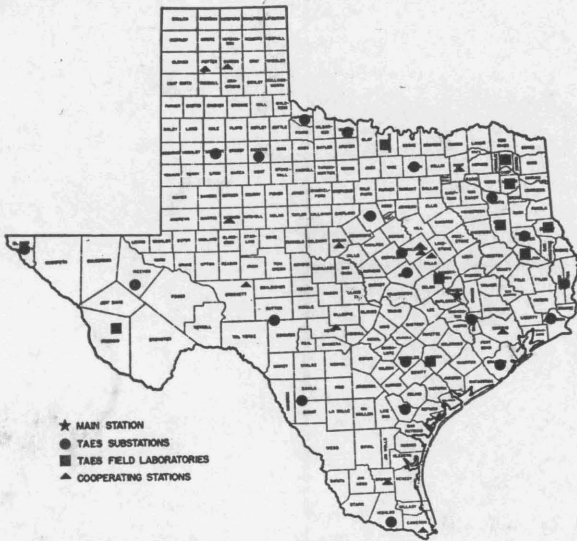
Use a concentration of 20 pounds of sodium dalapon and 4 pounds of Fab (wetting agent) in 100 gallons of



Figure 19. This shows the same field as Figure 18. Right, after one spot-spraying and cultivation; left, after cultivation only.

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State-wide Research



Location of field research units of the Texas Agricultural Experiment Station and cooperating agencies

The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of ten parts of the Texas A&M College System

ORGANIZATION

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies. Cooperating agencies include the Texas Forest Service, Game and Fish Commission of Texas, Texas Prison System, U. S. Department of Agriculture, University of Texas, Texas Technological College, Texas College of Arts and Industries and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

THE TEXAS STATION is conducting about 400 active research projects, grouped in 25 programs, which include all phases of agriculture in Texas. Among these are:

OPERATION

- | | |
|--------------------------------------|---------------------------------|
| Conservation and improvement of soil | Beef cattle |
| Conservation and use of water | Dairy cattle |
| Grasses and legumes | Sheep and goats |
| Grain crops | Swine |
| Cotton and other fiber crops | Chickens and turkeys |
| Vegetable crops | Animal diseases and parasites |
| Citrus and other subtropical fruits | Fish and game |
| Fruits and nuts | Farm and ranch engineering |
| Oil seed crops | Farm and ranch business |
| Ornamental plants | Marketing agricultural products |
| Brush and weeds | Rural home economics |
| Insects | Rural agricultural economics |
| | Plant diseases |

Two additional programs are maintenance and upkeep, and central services.

Research results are carried to Texas farmers, ranchmen and homemakers by county agents and specialists of the Texas Agricultural Extension Service

AGRICULTURAL RESEARCH seeks the WHATS, the WHYS, the WHENs, the WHEREs and the HOWs of hundreds of problems which confront operators of farms and ranches, and the many industries depending on or serving agriculture. Workers of the Main Station and the field units of the Texas Agricultural Experiment Station seek diligently to find solutions to these problems.

Today's Research Is Tomorrow's Progress