OVERVIEW OF U.S. REGIONAL COTTON DEFOLIATION PRACTICES--SOUTHWEST

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Abstract

Properly used, harvest aids enable growers to preserve and capture the yield and fiber quality potential of their cotton crops. Factors that influence the selection of the most appropriate harvest aid program in the Southwest include the production region in which the crop is being grown, the crop yield potential, and the method that will be used to harvest the crop (spindle pickers or strippers). Defoliation prior to harvest is expected to improve harvest efficiency and reduce leaf content and staining of lint. Good desiccation is the primary requirement for stripper harvesting, although defoliation and boll opening prior to desiccation should improve grades and hasten the opening of mature bolls.

Introduction

Southwest (Texas and Oklahoma) farmers annually plant in excess of 5-million acres of cotton in nine to ten relatively distinct production regions. Harvest-aid chemicals are tools that growers can utilize to preserve and capture the lint and seed yield and quality potential attained during the growing season through timely harvest. The selection of the most appropriate and cost effective crop termination program is based on several factors including: production region, the crop yield potential and the harvest method.

Production Regions

Cotton production in Texas can be subdivided into nine relatively distinct regions which are illustrated in Figure 1. The cotton growing areas in Oklahoma can also be regarded as a separate production region. These regions represent a broad range of soil types, climatic conditions, irrigation capabilities and pest complexes. Heat unit availability during the typical growing season range from >2800 in the Rio Grand Valley to <2000 in portions of the northern Texas High Plains. Annual rainfall varies from 40-inches or more in South Texas to 15-20 inches on the Plains and less than 10 inches in the El Paso area. Only 35-40% of the Texas cotton acreage is irrigated, mostly with water from limited underground reserves that are judiciously used to supplemental rainfall. Production systems also vary, even within regions. Some growers elect to use early maturing and more determinate varieties, whereas others opt to use longer season and more indeterminate varieties that may have somewhat higher yield potentials and require higher levels of inputs and management.

Regional considerations that must be taken into account in planning a cotton harvest aid program include the increased likelihood of hurricane activity in the Gulf of Mexico in August and September; the potential for early, crop damaging low temperatures on the Plains; and the increased probability of precipitation in all regions of the state during the harvest season. Even with "normal" conditions, regional variations in high and low temperatures have to be considered in choosing the most appropriate harvest aid chemical options.

For example, Dropp is frequently used to defoliate cotton in the southern part of the state (from the Rio Grande Valley to the southern Blacklands/Brazos River Valley), but is rarely used alone in the central and northern regions where both maximum and minimum temperatures tend to be lower during the defoliation season. Results of trials conducted near College Station in 1995 show that Dropp, used alone, provided good defoliation and some regrowth suppression and there was no advantage to the use of a Dropp + Prep tank mix in this test, Table 1. In a similar test conducted at Prosper, TX (200 miles north of College Station), Dropp alone resulted in very poor defoliation, whereas the Dropp + Prep combination was among the better treatments 7 days after application, Table 2. In contrast, Ginstar, a relatively new defoliant, did not exhibit the levels of temperature sensitivity noted with standard defoliants (Def/Folex, Dropp and Harvade) and typically provided levels of defoliation comparable to the "best" defoliant in the four Texas "Uniform Harvest Aid Performance and Quality Evaluation Trials, Table 3.

Crop Yield Potential

Potential crop yields and quality are important considerations in the selection of harvest aid programs, especially in the Southwest where yields in a given production region may range from less than 0.25 bales per acre to more than 2.5 bales per acre. Water (rainfall and irrigation), length of growing season, seasonal growing conditions, pest pressures and management are among factors that impact the yield potential in any given year.

Harvesting cotton when it is mature and as soon as possible after all harvestable bolls are open minimizes the potential for weather related deterioration of yield and quality. Properly used, harvest-aids can be used to prepare crop for earlier harvest. Defoliation removes leaves and thereby can contribute to a substantial improvement in leaf grades by reducing the thrash content in the fiber, even in stripper harvested cotton. The use of "boll openers" (ethephon) can accelerate opening of mature bolls and lead to earlier harvest. Desiccants are often needed to dry leaf and other

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plant tissues to allow stripper harvesting. Frequently, growers elect to use combination of these "chemical tools" to prepare crops for harvest.

The potential gains from a "perfect" harvest aid program, however, may be more than negated by the cost of the treatment(s) if they are used in fields with limited yield potentials. Anderson (1995) illustrates the relationship between yields and harvest aid costs in Table 4. His analysis shows that harvest aid costs of $30 per acre may be economically practical in fields with relatively high yield potentials, but such costs may not be justified in fields with substantially lower yield potentials. For example, the expenditure of $30/A in a field yielding 600 lbs/A "costs" the grower $0.05 per pound of lint produced. In contrast, a similar expenditure in a field yielding 200 lb/A would cost the grower $0.15/lb of lint produced.

Harvest Methods

The Southwest is somewhat unique in that two harvest methods, spindle picking and stripping, are widely used in this region of the US cottonbelt. Data compiled by the Commodity Economics Division, ERS, USDA shows that approximately 71% and 72% of the bales harvested in Texas and Oklahoma, respectively, during 1993-94 period were stripper harvested, Table 5.

Stripper harvesters have several advantages including lower equipment purchase and operating costs, higher harvesting capacity and the capability to efficiently harvest short-statured, low yielding crops. A disadvantage is that stripping is a once over harvest method that collects more trash (leaves, burs and fragments of limbs). Consequently, stripped cotton requires more cleaning at the gin, ginning costs are higher and grades are frequently lower. Additionally, preparation of cotton for once over stripper harvesting requires that all harvestable bolls be open and the crop be desiccated either with chemicals or by a killing freeze to insure that the moisture content of the stripped cotton is less than 12% to minimize the possibility of heating during field storage in modules or trailers.

In contrast, the primary requirement for preparing cotton for spindle picking is defoliation. Factors that help determine choice of harvest method include crop yield potential, harvest-aid costs, seasonal conditions, plant size and condition and equipment availability.

Changes In Practices

The Southwest, like other regions in the cottonbelt, has undergone changes which have impacted harvest aid practices. These include: loss of a primary desiccant (arsenic acid), greater emphasis of quality and quality preservation brought about at least partially by HVI testing, a shift to slightly later maturing varieties and the decline in number of gins coupled with steadily increasing use of the module builder.

Due largely to the loss of arsenic acid, a very cost effective desiccant that was widely used in the Southwest from the mid 1950's through 1993, and the higher cost of alternative harvest aids, there has been some increase in the use of spindle pickers primarily in the Coastal Bend and Blacklands regions of Texas. Result of recent field trials show that the use of pickers in these region becomes an economically viable option when yields potentials reach or exceed 400-450 lbs/A (Supak, 1995).

In regions such as the Texas High Plains where about 98% of the acreage is stripped, however, the loss of arsenic acid has had little impact on the choice of harvest methods. In this area, the crops typically mature in October. At about this time, nighttime temperatures begin to drop and promote leaf senescence. Under these conditions, paraquat is an effective desiccant. Additionally, this region has a high probability of receiving a killing freeze by early November. Both the chemical and freeze are effective in preparing cotton for once over harvest with strippers.

In the Southwest, the number of bales produced annually tends to fluctuate according to acreage allotments and seasonal growing conditions, but over the long term (last 15-20 years) has remained more or less constant, Figure 2. During the same period, the number of active gins has declined while the capacity of gins has increased steadily. Simultaneously, the percent of bales that are moduled has increased markedly since the module builder was introduced in 1974. Industry-wide, there has been an increasing emphasis of fiber quality resulting in part from the adoption of HVI fiber testing. In the last 5 years or so many growers have also shifted to slightly later maturing and more indeterminate varieties that generally exhibit somewhat higher yield potentials and produce better quality fiber. As a consequence, the use of defoliants and defoliant + boll opener combinations have become more common in stripper areas as growers attempt to reduce the thrash content of the fiber and to harvest crops in a more timely manner. Growers are also more conscious about properly timing harvest aid applications to avoid or minimize any loss in yield or quality.

Common Harvest Aid Practices

The selection of the most effective harvest aid treatment(s) varies by region and even by community. It is recommended that growers and consultants review harvest aid guidelines developed by local Extension and research personnel to identify treatments which are recommended for their specific areas. Nevertheless, some generalizations can be made for all regions based on harvest method.

Stripper Harvest: Producers generally rely on one of three options to prepare cotton for stripper harvesting. These

include: 1) Apply only a desiccant (currently, paraquat--Cyclone, Starfire--is the only material registered for this use) as a single treatment or in sequential applications; 2) Apply a defoliant followed by a desiccant; or, 3) Apply a defoliant + boll opener tank mix combination followed by a desiccant.

The single application of paraquat is most applicable for use on short-statured cotton with limited yield potential. Typically, this treatment results in very little defoliation (20% or less) and its use is primarily intended to dry leaf and other plant tissues. The use of sequential applications of the desiccant (i.e. 0.5 pt/A of paraquat at 60-70% open bolls followed by 1.5 pt/A 5-7 days later) is a lower cost alternative to option 2 above, and is primarily applicable in the northern regions of the Southwest. The low rate of paraquat does result in some defoliation (usually 40 to 60%) and "conditions" the crop for more complete desiccation with the second treatment.

Defoliation prior to desiccation removes most of the leaves and also conditions the crop for more complete desiccation with the second (desiccant) treatment. Removal of most of the leaves should reduce the amount of thrash in the harvested cotton and contribute to better leaf and possibly color grades. Tank mixing a boll opener with the defoliant frequently improves defoliation and hastens opening of mature bolls. In situations where the defoliants (options 2 and 3) remove 95% or more of the leaves, it may be possible to strip the crop without applying the desiccant treatment. Also, in the northern regions, only the initial treatment may be applied and used as a means of conditioning the crop for a killing freeze. The use of harvest aids prior to a hard freeze can speed defoliation, allow more mature (or near mature) bolls to open and result in an earlier harvest.

Picker Harvest: In most instances, a single application of proven defoliant or defoliant combination is sufficient to prepare cotton for spindle picking. Fields with tall, rank cotton may need sequential applications of defoliants to provide sufficient leaf shedding to minimize green leaf fragments and lint staining during harvest. Preparation of cotton for once over harvest with pickers is often accomplished with one tank mix application of a defoliant + boll opener. In fields with tall, frequently lodged plants and dense foliage, a defoliation treatment followed by a subsequent application of a boll opener + defoliant may be needed to prepare cotton for once over harvest.

Typically, desiccants are not used in preparing cotton for picking. Occasionally, however, low rates of paraquat are mixed with a defoliant to "enhance" leaf shedding. Full labelled rates of paraquat alone or in combination with other harvest aids may also be used to desiccate weeds that would otherwise interfere with the harvesting operations.

Regrowth Control: Control of regrowth may be a consideration in fields intended for either picker or stripper harvest, especially in the southern regions of Texas. Some defoliants (i.e. Dropp, Ginstar) will suppress regrowth but only for limited periods (2-weeks or less in South Texas). Landivar et al (1994) has shown that relatively low rates of Roundup (0.5-.75 pt/A) applied at approximately 40% open bolls can provide extended regrowth control (55 days or more) with no adverse effects on yield or quality. Tank mixing Roundup with defoliants has provided somewhat erratic results with regard to regrowth suppression. In some instances this mixture has been very effective in terms of both defoliation and regrowth control. In others (primarily in drought stressed cotton) it has decreased the level of defoliation and provided little or no regrowth suppression.

Regional Needs

Thanks in part to the "Uniform Harvest Aid Performance and Fiber Quality Evaluation" trials, regional harvest aid recommendations have been refined and at least one new product (Ginstar) has entered the market place and been added to the list of recommended products. Yet, there is still a need for additional products. These would include a desiccant(s) comparable to arsenic acid in efficacy and cost, defoliants and boll openers with reduced temperature sensitivity and products that perform multiple functions (i.e. defoliation, boll opening, regrowth suppression). Additionally, hard data is needed to establish how much defoliation is economically justifiable, especially in stripper areas. Data collected from the Uniform Harvest Aid Performance and Fiber Quality Evaluation trials in the Southwest region indicate that defoliation treatments have a relatively small effect on leaf grades and HVI trash content.

Summary

The primary reason for using harvest aids should be to increase grower profits. This objective is achieved by allowing growers to harvest their crops in a timely manner, enabling them to better schedule harvest equipment and labor, improving harvesting and ginning efficiencies, and reducing the risk of damage to fiber and seed during field storage. Producers have a wide range of harvest aid options that can be used. The most appropriate option for their individual operations will be largely determined by their location (production region), the crop yield potential and the harvest method they elect to use.

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Disclaimer

Reference to products or trade names is made with the understanding that no discrimination or endorsement is intended by the author, the Texas Agricultural Extension Service or Texas A&M University.

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Table 1. Defoliation and regrowth suppression obtained with the core treatments at College Station, TX*.

Treatment	Rate (Per Ac)	% Defol 7 DAT	% Defol 14 DAT	% Tr Rgr 21 DAT
Check	--	29	54	100
Def/Folex	1.5 pt	50	71	100
Dropp	0.2 lbs	83	87	44
Harvade+	0.5 pt	45	65	100
COC	1.0 pt			
Harvade+	0.4 pt	59	70	100
Prep+	1.3 pt			
COC	1.0 pt			
Def/Fol+	0.75 pt	62	74	97
Prep	1.3 pt			
Dropp+	0.1 lb	71	80	91
Prep	1.3 pt			

*1995 Uniform Harvest Aid and Fiber Quality Evaluation Trial

Table 2. Defoliation, desiccation and regrowth suppression obtained with core treatments at Prosper, TX*.

Treatment**	Rate (Per Ac)	% Defol 7 DAT	% Defol 14 DAT	% Def+ Des 14 DAT	% B Rgr 21 DAT
Check	-	4	5	100	6
Def/Folex	1.5 pt	40	48	100	9
Dropp	0.2 lbs	9	13	96	11
Harvade+	0.5 pt	21	21	99	12
COC	1.0 pt				
Harvade+	0.4 pt	37	35	99	13
Prep+	1.3 pt				
COC	1.0 pt				
Def/Folex+	.75 pt	56	77	100	11
Prep	1.3 pt				
Dropp+	0.1 lb	49	61	99	12
Prep	1.3 pt				

* 1995 Uniform Harvest Aid and Fiber Quality Evaluation Trial
** fb 2.0 pts Cyclone at 5-7 DAT

Table 3. Defoliation and regrowth suppression obtained with "best" core defoliant treatment and with Ginstar*.

Treatment	Rate (per Ac)	% Defol 7 DAT	% Defol 14 DAT	% Tr Rgr 21 DAT
Weslaco, TX				
Dropp+	0.1 lbs	63	52	7
Prep	1.3 pt			
Ginstar	0.5 pt	78	82	7
College Station, TX				
Dropp	0.2 lbs	83	87	44
Ginstar	0.5 pt	83	93	24
Prosper, TX				
Folex+	0.75 pt	56	77	0
Prep	1.3 pt			
Ginstar	0.5 pt	62	90	0
Lubbock, TX				
Folex+	0.75 pt	79	93	0
Prep	1.3 pt			
Ginstar	0.5 pt	67	93	0

* 1995 Uniform Harvest Aid and Fiber Quality Evaluation Trials - Texas

Table 4. Harvest aid chemical and application costs per pound of lint produced for 5 yield levels.*

Cost ($/Ac)	Yield (lbs/Ac) 200	300	400	500	600
	cents/lb lint produced				
10	5.00	3.33	2.50	2.00	1.67
15	7.50	5.00	3.75	3.00	2.50
20	10.00	6.67	5.00	4.00	3.33
25	12.50	8.33	6.25	5.00	4.17
30	15.00	10.00	7.50	6.00	5.00

* Anderson, C.G. 1995.

Table 5. Percentages of the Texas and Oklahoma cotton crops that were machine stripped and picked in 1993-94 and 1994-95.*

State/Region	1993-94 % of Bales*		1994-95 % Acres Harv.**	
Texas	71	29	83	17
- Lower Rio Grande Valley			10	90
- Coastal Bend			30	70
- Upper Coast			10	90
- Blacklands			75	25
Oklahoma	72	28	92	8

* From: USDA-ERS Commodity Economics Division
** From: Surveys conducted by C.G. Anderson, Extension Economist-Cotton Marketing, Texas Agricultural Extension Service, and J.C. Banks, Extension Specialist-Cotton, Oklahoma Cooperative Extension Service.

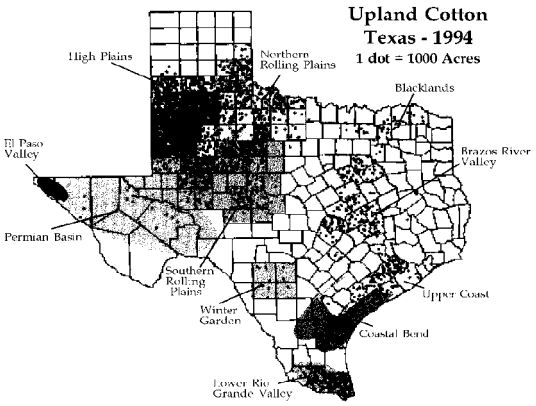

Figure 1. Cotton production regions and acreage distribution in Texas. (1994 Texas Crop Statistics)

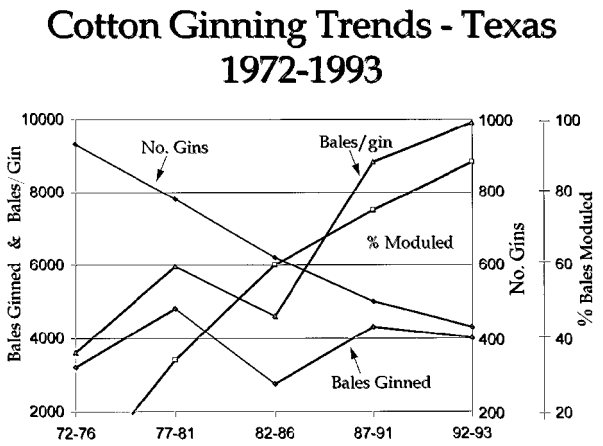

Figure 2. Cotton yield, ginning and seed cotton moduling trends. 1972-1993. (Cotton Ginning Statistics)