# 2007 High Plains and Northern Rolling Plains Cotton Harvest-Aid Guide

**Dr. Randy Boman, Extension Agronomist-Cotton, Texas Cooperative Extension;**
**Dr. Mark Kelley, Extension Program Specialist-Cotton, Texas Cooperative Extension;**
**Dr. Wayne Keeling, Systems Agronomist, Texas Agricultural Experiment Station;**
**Dr. Alan Brashears, Agricultural Engineer, USDA-ARS (Retired);**
**Lubbock, TX**
**and Dr. Todd Baughman, Extension Agronomist, Texas Cooperative Extension,**
**Vernon, TX**

## INTRODUCTION

Harvest-aid chemicals are generally applied to hasten harvest of a mature crop, and to reduce potential preharvest losses of lint yield and fiber quality. Proper use of harvest aids can result in earlier harvest, preservation of fiber quality, and fewer seed quality reductions due to field exposure. Weathering losses in the High Plains can result in considerable reduction in dollar value of the crop, unless measures are undertaken to protect yield and quality potential. This is especially true for open boll picker-type varieties and lesser storm-proof stripper types. Timing of harvest-aid chemical applications is critical and different methods and considerations for determining the correct time may be utilized. Premature harvest-aid applications can result in loss of lint and seed yield and reduced fiber quality which ultimately can result in reduced profits or greater economic losses. Although studies indicate that maximum yield and quality occur at different stages, correct timing of harvest-aid applications can enable producers to obtain optimum yields of high quality lint and seed. However, even when applications are made under ideal conditions, inclement weather or lack of available machinery and/or labor can delay harvest for several days or longer. Delayed harvest timings can have adverse effects on both yield and quality of lint and seed. Cotton producers on the Texas High Plains, and across the Cotton Belt, face difficult decisions at harvest time that have profound impact on yield and quality. A comprehensive 3-year project (2000-2002) to address the fundamental data requirements of stripper harvested cotton was conducted in the Texas High Plains near Lubbock. A field near Lubbock planted to a storm-proof cultivar, Paymaster 2326RR, was used, and the treatment structure included harvest-aid chemical termination with varied harvest dates. Lint yields were reduced with later harvest dates one out of three years. Also, results from HVI analyses indicated significant reductions in fiber quality when harvest was delayed, most notably were length, strength and color grades. These fiber quality reductions subsequently resulted in lower lint loan values and ultimately, lower net values per acre. When considering planting seed quality, later harvest dates tended to reduce germination percentages two out of three years. This is an important consideration for individuals producing planting seed for companies or for those that retain seed for planting next year's crop. Even though a storm-proof cultivar was utilized during this study, the results indicate that significant reductions in lint yield, HVI fiber quality, resulting economic returns, and seed quality can occur if harvest is delayed. Greater losses may be incurred with delayed harvest if a cultivar with a lesser degree of storm resistance is produced. Results from this project, as well as from previous research, stress the importance of timely harvest aid applications and subsequent harvest for optimizing yield and fiber quality for greater net returns.

Proper harvest-aid material selection, tank mix partners and rates vary with environmental and crop conditions. What works best in one year is not necessarily the best for the next season. Efficacy of harvest-aid chemicals is always a concern. There are several factors that affect the performance or lack of performance of harvest-aid chemicals.

Some factors that increase the performance of harvest-aid chemicals include the following:

- Warm, calm, sunny weather
- Soil moisture relatively low but sufficient to maintain cotton plant in active growth condition without moisture stress
- Soil nitrogen levels relatively low
- Leaves active and uniformly expanded on plants
- Little or no secondary growth evident on plants
- Plants with a high percentage of open bolls that have shed some mature leaves

Conversely, some of the factors which negatively affect harvest-aid chemical performance include:

- Applications made under cool (below 60$^{o}$ F), cloudy conditions
- Prolonged periods of wet weather following treatment
- Plants in vegetative growth state with low fruit set
- Plants severely moisture stressed with tough, leathery leaves at time of treatment
- High soil moisture and nitrogen levels which contribute to rank, dense foliage and delayed maturity
- Plants exhibiting secondary growth (regrowth) following a "cutout" period
- Improper calibration of application rates and poor spray coverage

**CROP MATURITY DETERMINATION**

Crop maturity determination is critical for a successful harvest-aid program. Premature crop termination has been shown to reduce lint yield, seed quality, micronaire, and fiber strength. Desiccants generally abruptly terminate fiber and plant development. **Harvest-aid chemicals cannot increase the rate of fiber development.** Only additional good growing weather including open skies and adequate heat units combined with functional leaves can mature cotton bolls. Maturity can be determined by using a sharp knife to cut into the bolls. If the boll is watery or jelly-like on the inside, then it is immature and needs more heat units. If boll development is such that the knife cannot slice through the lint, then the boll is nearly mature. Close inspection of the seed will give further indication of boll maturity. If the seed coat is turning tan and the seed leaves (or cotyledons) are fully developed, the boll is mature.

When determining boll maturity of adjacent fruit, one can consider the following. When moving up the plant from a first position boll that has just cracked to a first position unopened boll on the next fruiting branch, about 60 additional heat units (DD60s) are required to obtain similar boll maturity. If moving out from a first position boll to a second position boll on the same fruiting branch, about 120 heat units will be required to reach the same level of maturity. For an individual boll, a total of about 800-850 heat units are required after pollination to produce normal size and quality. However, bolls obtaining fewer heat units may still make productive lint of lower micronaire that may contribute to final yield.

Nodes above cracked boll (NACB) is a tool that can be used to time harvest aid application (Figure 1). A Beltwide cotton harvest aid project was conducted over multiple sites and years by Kerby, Supak, Banks, and Snipes. It was determined that if the uppermost first position-cracked boll is within three nodes of the uppermost harvestable first position boll then no lint weight will be lost if a defoliant-type harvest aid is applied at that time (Figures 1 and 2). However, if the uppermost harvestable first position boll is four or more nodes above the uppermost first position cracked boll, then potential for some lint loss exists. The lint loss potential increases as the NACB increases. Micronaire reduction generally follows a similar pattern when using the nodes above cracked boll criterion. When defoliant type chemicals are applied, some slight subsequent fiber development may occur before defoliation. If applying desiccants, more bolls must be mature in order to reduce the risk of fiber weight loss or reduction of micronaire, thus two to three NACB would be a better target.

**Figure 1. Determining nodes above cracked boll.**

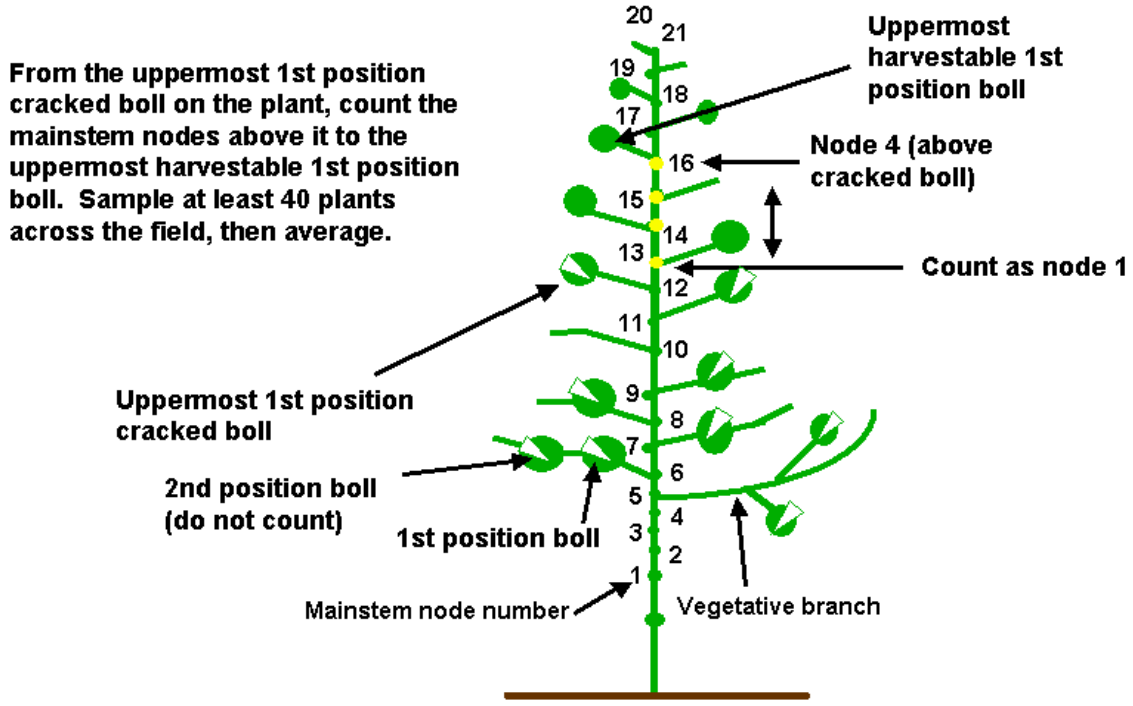
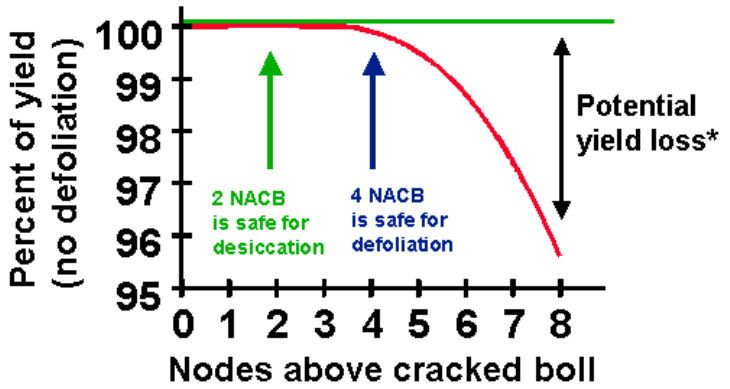


**Figure 2. Potential yield loss based on NACB method.**




*** when desiccating, add 2 to value for NACB to determine the effect on yield (desiccation at 2 NACB=percent of yield at 4 NACB for defoliation)**

Kerby, Supak, Banks, and Snipes

**HARVEST-AID CHEMICAL TYPES**

Harvest aids are basically classed in three categories – desiccants, defoliants, and boll openers. Desiccants (paraquat formulations such as Gramoxone Inteon, Firestorm and various tank-mixes) dry down the plant by causing the cells to rupture. The old "rule of thumb" is that desiccants are normally applied when approximately 80 percent of the productive bolls are open, or at 2-3 nodes above cracked boll. However if sufficient numbers of bolls are mature, based on the knife test, then these chemicals may be applied to somewhat lower percent open boll fields. **Gramaxone Inteon and Firestorm are similar products in that paraquat is the active ingredient in both formulations. The most important difference is in pounds of active ingredient per gallon. Gramoxone Inteon is a 2 lb/gallon formulation, whereas Firestorm is a 3 lb/gallon product. A conversion table that provides equivalent active ingredient rates in lb/acre for both formulations can be found in the Decision Aid Table section of this publication.** A 24c special local needs (SLN) label has been granted by the Texas Department of Agriculture (TDA) for Gramoxone Inteon for most of Texas. This SLN has approved higher use rates for desiccation of stripper harvested cotton. However, an SLN label has yet to be granted for Firestorm which currently has a maximum use rate of 1.3 pts/acre per season as a cotton harvest aid.

Applications of Gramoxone Inteon or Firestorm made in the late afternoon prior to a bright, sunny day appear to enhance the effectiveness of desiccation and tend to increase regrowth control. Use of non-ionic surfactant (NIS) at a minimum rate of 0.125% or 0.25% volume/volume (v/v), depending on the % concentration of surface-active agent (see individual labels) with paraquat is suggested. It may be necessary to increase the NIS rate to 1% v/v and spray late in the day to effectively desiccate some fields. In some years, Aim 2EC, Blizzard, ET 2.5%EC, or Resource (see product descriptions below in the defoliant section) when applied at higher rates work well to desiccate juvenile growth and regrowth, which is many times difficult to accomplish with paraquat.

Defoliants (Ginstar, Def/Folex, Harvade, Aim 2EC, Blizzard, ET 2.5%EC, Resource, Dropp, FreeFall, sodium chlorates, Gramoxone Inteon at low rates, and other products) result in initiation of

an abscission layer at the base of the leaf petiole where it attaches to the stem. The natural abscission layer formation process is enhanced by the defoliant, which results in leaf drop. In order to obtain maximum leaf drop, defoliants require fairly healthy and active leaves which still properly function and are not severely drought stressed (tough and leathery). Warm air temperatures generally enhance activity. The commonly used rule of thumb is that defoliants can be safely applied when 50-60 percent of the bolls are open and the remaining bolls are of sufficient maturity to obtain desired yield. Although a boll opening response is generally obtained as a result of defoliation, green unopened bolls can still remain a problem. Many times a follow-up application of paraquat or other chemicals with desiccant activity or a killing freeze is necessary to allow stripper harvest of the crop. Aim 2EC, Blizzard, ET 2.5%EC, and Resource belong to the chemical class protoporphyrinogen oxidase (PPO) inhibitors. **Blizzard from Chemtura is new for 2007.** Research conducted with Blizzard in the High Plains in 2006 indicated that the product performed similarly to others in the PPO chemistry in that specific year. Aim 2EC, Blizzard, ET 2.5%EC, and Resource cause disruption of cell membranes, which in turn triggers increased ethylene in leaves. Recent research trials have indicated that these products can be effective defoliants, as well as desiccants in some instances when used at higher rates. Aim 2EC, Blizzard, ET 2.5%EC, and Resource can be tank mixed with other products such as FirstPick, Gramoxone Inteon, Def/Folex, Prep, Finish 6 Pro, and Ginstar. **Use of crop oil concentrate (COC) is suggested for the Aim 2EC, Blizzard, ET 2.5%EC, and Resource spray mixtures. See specific product labels for details. Failure to include COC with these products will likely result in significantly reduced activity.**

Boll openers (Prep and other generic products such as Ethephon 6, SuperBoll, Boll'd) and boll openers-defoliants (such as Finish 6 Pro and FirstPick which are ethephon products with additional synergists cyclanilide and AMADS, respectively) enhance boll opening to allow for more timely harvesting of the crop. **DuPont removed CottonQuik from the market in 2006 and replaced it with FirstPick. The active ingredient concentration (for both the AMADS synergist and ethephon) is the same for both products. The formulation change is described as a "water soluble emulsifiable concentrate that has reduced corrosivity and different surfactants." FirstPick has performed similarly to CottonQuik.** These chemicals affect natural plant processes associated with boll opening, but do not increase the rate of boll or fiber maturation. Once inside the plant, ethephon is converted to ethylene, a plant hormone which increases the rate of abscission layer formation. These chemicals result in significant defoliation responses at high rates, but generally are applied at lower rates to obtain boll opening. Defoliant chemicals can be tank mixed with normal use rates of ethephon products to enhance defoliation. The response to ethephon is generally driven by temperatures. Under warmer conditions, reduced rates of ethephon may be used compared to cooler temperature regimes where higher rates are required to obtain similar plant responses. Ethephon product labels generally state that there should be "sufficient mature unopened bolls present to produce desired crop." Mature bolls are defined as "too hard to be dented when squeezed between the thumb and fingers, too hard to be sliced with a sharp knife, and when the seedcoat becomes light brown in color." Applications of boll opening products when bolls lack adequate maturity will likely result in reduced lint yield and micronaire. Results from several High Plains studies indicate that reductions occurred when applications were made at 25 percent open bolls, but not at 50 percent open bolls. Lint yields were reduced at least 10 percent, and micronaire was decreased by about 5 percent. A follow-up application of paraquat (or other product with desiccant activity) is generally required to sufficiently condition the crop for stripper harvest.

Glyphosate can be applied as a harvest aid to non Roundup Ready/Roundup Ready Flex or conventional cotton specifically to target weed problems and/or to reduce regrowth potential. Effective silverleaf nightshade (or whiteweed) control can be observed in the following season with application of 1-2 quarts per acre of glyphosate when weeds are in the green-berry stage. Control of severe weed

infestations may be increased by the higher rate. Research has shown that reductions in weed populations of up to 97 percent can be obtained from such an application. Applications made in September should target cotton that is 50-80 percent open. After October 1, cotton can be treated when 30 percent of the bolls are open.

**Regrowth in Roundup Ready and Roundup Ready Flex cotton varieties will not be controlled by glyphosate application**. Glyphosate also should not be applied, at this time, to non-Roundup Ready Flex fields grown for seed production since viability and/or vigor of seed may be reduced. Recent Roundup Ready Flex label changes pertaining to seed production have been made. See the label for specific details.

## APPLICATION CONSIDERATIONS

In general, the yield and condition of the cotton should determine the type of harvest aid material chosen. If the leaves are beginning to shed and have reddish to purple pigmentation present, they will be easier to drop off the plant without excessive "leaf stick." "Sticking" occurs when the leaves do not drop and are frozen on the plant. The natural abscission layer forming process at the base of the leaf petiole was abruptly halted by physiological stress such as a freeze or desiccant application. Some cotton varieties do not readily form abscission layers even on older leaves and may not defoliate properly. If the leaves "stick," then lint quality can be reduced due to increased leaf content in the fiber. Drought-stressed leaves generally have a much thicker waxy cuticle on the surface. This can considerably affect harvest-aid performance.

Cotton secondary growth (or “regrowth”) sometimes occurs after the plants have "cutout" or stopped blooming due to drought stress or physiological maturity. If warm temperatures and rainfall are then encountered, the cotton plant growth cycle can start again, and one can find secondary growth in the terminal and on many of the other nodes on the plant. Plants with unopened bolls or young, developing bolls are less likely to produce secondary growth, although application made at this stage can result in reduced lint quality and yield. Secondary growth is difficult to control since young foliage does not form abscission layers or shed as older leaves do. Research has shown that, in general, the PPO inhibitor harvest aid chemicals tend to produce more favorable results for controlling regrowth.

Proper spray volume and coverage are also critical to the success of a harvest-aid program. Be sure to calibrate the sprayer to deliver the correct volume and nozzle pressure to ensure adequate distribution and foliage penetration. **Read and follow the label directions for use of the product.** The harvest-aid label contains information based on many years of testing and results. **Avoid applying on windy days to reduce the hazard of spray drift to nontarget vegetation.** Some harvest-aid chemicals are very toxic when ingested, and should be properly handled and stored, especially around small children and pets.

## CHEMICAL SELECTION DECISIONS FOR STRIPPER HARVESTED COTTON

For lower yielding cotton (generally less than 400 lb per acre lint yield) a paraquat-based desiccant such as Gramoxone Inteon or Firestorm is generally recommended. If the plants are large and have considerable green leaves remaining, sequential applications of low rates of desiccants are sometimes used to promote defoliation and reduce leaf sticking. Use of paraquat-based desiccants should be discouraged when seedling wheat, or other crop species, are in close proximity to targeted cotton fields. **Drift from paraquat can cause severe damage to developing small grains plants**

**grown for cover or harvest.** Unlike with paraquat, drift from desiccant rates of PPO inhibitor products (such as Aim, Blizzard, ET and perhaps Resource) should not injure small grains.

For cotton yielding in excess of one bale per acre, other chemicals can be used and the higher costs more easily justified. Ethephon-based products result in an increased rate of boll opening and defoliation that generally reaches a maximum within 14 days. Tank mixes of ethephon and defoliants (such as Def/Folex or Ginstar) are effective in higher yielding cotton to open bolls and drop leaves. Warm temperatures (80$^{o}$ F) are normally required to obtain the maximum boll opening response, although higher rates of ethephon are still effective under cooler temperature conditions. Finish 6 Pro has 6 lb ethephon/gallon combined with a proprietary synergist cyclanilide (0.375 lb/gallon). Cyclanilide is reported to be an effective inhibitor of auxin transport and binding which should result in increased abscission activity. In order to obtain desirable levels of defoliation with Finish 6 Pro, tank mixes of low rates of defoliants are many times required. FirstPick is another ethephon-based material (2.28 lb ethephon/gallon or 18.3 percent a.i.) which has a synergist identified as AMADS (58.6 percent a.i.). Sixteen to 21 oz per acre of ethephon (when using 6-lb/gallon material, equivalent to 0.75-1 lb per acre a.i.) when tank mixed with low rates (3-5 oz per acre) of Ginstar typically result in good defoliation, boll opening response and in many instances good regrowth control. Ginstar is a good defoliant that is also one of the most effective products for controlling regrowth, and works over a fairly wide range of environmental conditions. Tank mixes of ethephon and Ginstar are fairly expensive, and can be used for boll opening and defoliation of cotton with high yield potential.

When boll openers and defoliants are used, a follow-up application of paraquat (or other product with desiccant activity) is often required to sufficiently condition the cotton for stripper harvest in the High Plains region. Although this adds more expense to the overall harvest-aid program, it is sometimes necessary in order to complete the season-long earliness investment the producer has made.

## CHEMICAL SELECTION DECISIONS FOR SPINDLE PICKER HARVESTED COTTON

For high yielding picker-type varieties, spindle picking may be a good option for some producers. Some recently conducted trials indicate that micronaire values of harvested lint may be increased by about 0.3 units when spindle picked versus stripper harvested. Harvest efficiency may be somewhat lower with spindle picking, but many fiber properties and gin turnout are generally improved when harvested in a timely manner. Seedcotton remaining in the field after spindle picker harvesting is generally of poor quality, including low micronaire. Selecting harvest aid chemicals for picker harvesting is similar to selecting for stripper harvest in higher yielding cotton. Differences, however, do exist. **These differences include the reduced necessity to remove all green leaves from the plant and elimination of the need for sequential applications of paraquat for crop conditioning**. Furthermore, some immature unopened bolls may not be a concern, as these bolls will most likely not make it to the basket and those that do could contribute to lower micronaire. When spindle picking high yielding cotton, greater expense for harvest aids can be justified with greater returns. Rapid boll opening and defoliation are the objectives when considering harvest aid chemicals for spindle picking. This will allow quicker harvesting with reduced risk from High Plains meteorological events. Tank mixes of ethephon (including premium ethephon products such as Finish 6 Pro and FirstPick) and defoliants (such as Def/Folex or Ginstar) are effective in higher yielding cotton to hasten boll opening and drop leaves. Finish 6 Pro has 6 lb ethephon/gallon combined with a proprietary synergist cyclanilide (0.375 lb/gallon). Cyclanilide is reported to be an effective inhibitor of auxin transport and binding which should result in increased abscission activity. In order to obtain desirable levels of defoliation with Finish 6 Pro, tank mixes of low rates of defoliants are many times required. FirstPick is another ethephon-based material (2.28 lb ethephon/gallon or 18.3 percent a.i.) which has

a synergist identified as AMADS (58.6 percent a.i.). Warm temperatures (80° F) are normally required to obtain the maximum boll opening response, although higher rates of ethephon are still effective under cooler temperature conditions.

## LATE SEASON INSECT MANAGEMENT AND REDUCTION OF STICKY COTTON POTENTIAL

Sticky cotton problems plagued the High Plains a few years ago, and mills were reluctant to purchase contaminated bales. During fiber laydown at the mill, one contaminated bale can affect as many as 25 to 50 other bales, resulting in increased maintenance and cleaning costs, more down time, and considerable financial losses for the mill. This problem results in a backlash by the mills, reducing the marketability of High Plains cotton. Lack of commercial testing equipment for determining "sticky" bales results in boycotting of the region's cotton by most mills. High Plains producers have come a long way in improving the reputation of the region's cotton due to the introduction of higher strength, longer staple varieties. Sticky cotton concerns are still with us and in order to preserve the hard-earned reputation of good quality, measures should be taken by producers to reduce the potential of the problem. Late season aphid buildups and resultant honeydew-derived sticky cotton can and should be reduced by insecticide applications and timely chemical termination of the crop. Refer to the section on crop maturity determination for more information. Dryland producers should consider using low-cost desiccants such as paraquat-based products on fields that experienced premature cutout due to drought. Short plants with low yield potential and 80 percent open bolls (or when two to three unopened first position bolls are above the uppermost first position cracked boll - also called nodes above cracked boll) can usually be terminated using paraquat. **Significant amounts of honeydew and dust on leaves can reduce the effectiveness of paraquat-based products**. Producers of irrigated cotton should carefully watch the maturity of their crop. When an adequate percentage of mature bolls is reached, defoliants and boll openers should be applied. Timely termination of irrigated fields will greatly reduce the leaf area necessary for aphids to feed and produce honeydew, thus reducing the potential for sticky cotton problems in harvested lint.

## STRIPPER HARVESTING CONSIDERATIONS

Harvest aid applications should be timed such that harvestable cotton fields coincide with harvesting capacity of strippers and other equipment. If harvest is initiated too early or delayed too long, bark potential is increased. Generally, a one to two week “curing out” period is necessary after desiccant application. Harvest as soon as possible after plants are sufficiently conditioned for harvest, but be aware that harvesting too quickly after harvest-aid application may result in barky grades and/or other quality discounts. Avoid long-term weathering of stalks when possible. Brittle stalks contribute to high stick content, which results in increased bark potential. Strippers should be adjusted to reduce foreign matter. When necessary, readjust the stripper when moving from field to field or as conditions change.

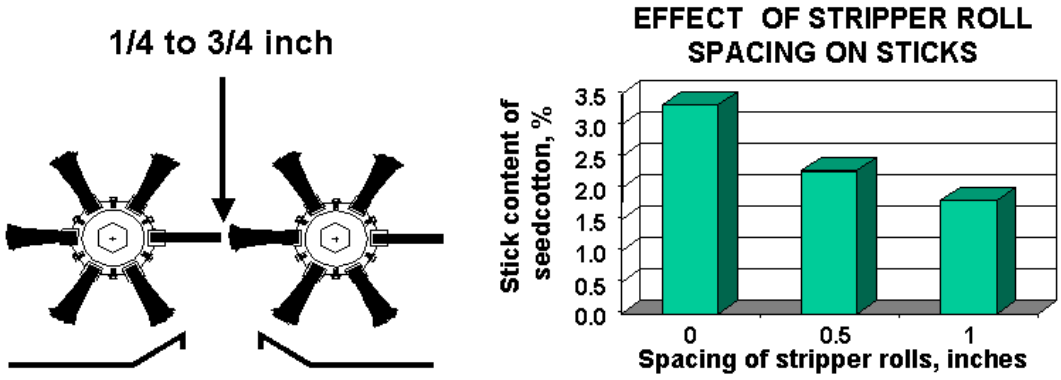
USDA-ARS researchers at Lubbock have determined that use of 5 brush/1 bat or 3 brush/2 brush-bats/1 bat configurations will generally reduce foreign matter content (particularly sticks) in seedcotton, compared to 3 brush/3 bat configurations (Figure 3). It is best to time stripper rolls brush-to-bat with such patterns. Widen spacings between stripper rolls as far apart as acceptable seedcotton loss permits. Wider spacings can considerably reduce stick content of stripped cotton, thus reducing potential for bark problems (Figure 4). When plants become brittle late in the season, reducing paddle length by 0.75 to 1 inch on brush-roll headers can reduce stick content as much as 40 percent. If shortened paddles are used, stripper rolls should be timed brush-to-brush.

Combing pans (mounted on the underside of the stripper heads and directly under the stripper rolls) should be adjusted to their widest spacing depending upon stripper roll spacing. A wider pan spacing at the front of the header than at the back or upper end of the stripper rolls is advisable as the largest mass of the cotton plants will be near the bottom of the stripper roll. These pans cannot be completely removed as seedcotton losses will be excessive, but the wider spacing will help to reduce leaf trash.

Whenever the strippers are adjusted for the field specific conditions, remember that some tagging may be acceptable, especially if the amount of foreign material can be reduced by less aggressive stripping. Yield losses can be estimated by measuring 10 feet behind your harvester and collecting the seedcotton. If there is an average of 2.5 seeds per foot behind one row of the harvester unit, then about 4-5 lbs of lint per acre harvest loss is expected. This number is for 40-inch row machines. For 30-inch rows, the number for the same loss is about 1.9 seeds per foot of row.

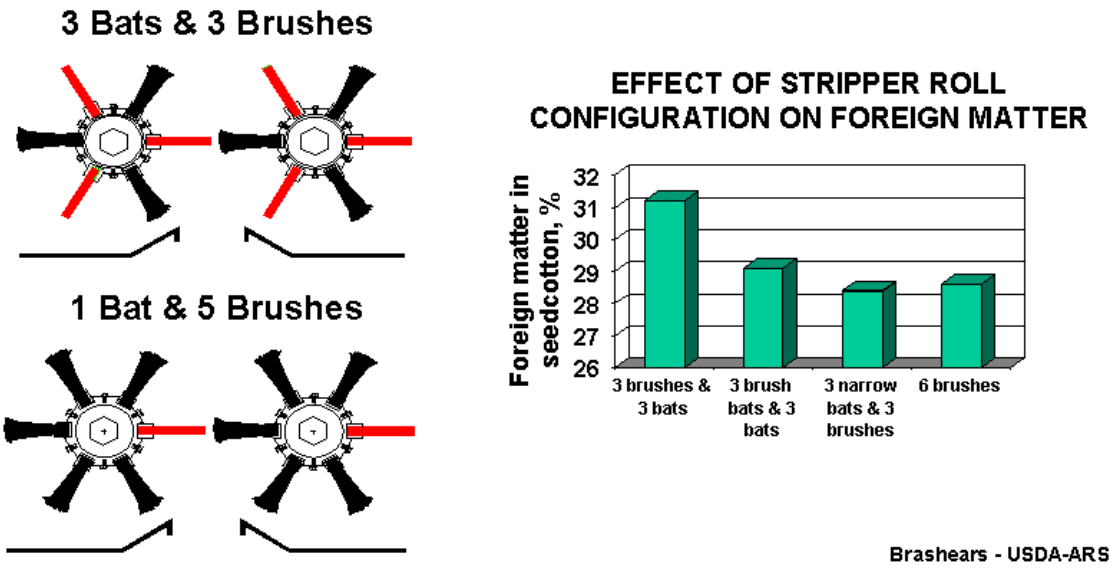
When harvesting begins and cotton is stored in modules, moisture content of the stripped material must be less than 12 percent. This will ensure that there will be no heating in the module, and that lint staining due to green plant material will be minimized. Cotton is ready to strip when leaves are dry and bolls easily snap off plants. No surface moisture or water droplets (such as dew) should be present.

**Figure 4. Spacing of stripper rolls.**




Brashears - USDA-ARS

## Figure 3. Configuration of bats and brushes.




### PREVENTION OF LINT CONTAMINATION

Contaminants are a significant problem during subsequent lint processing by mills and care should be taken to reduce contamination potential. Various materials that are picked up by strippers and carried through the ginning process can end up in the bale of cotton, and ultimately impact the quality of yarn and fabric products. During fiber laydown at the mill, one contaminated bale could affect as many as 25 to 50 other bales, resulting in considerable financial losses. Liability issues may soon become a reality. Since cotton is a natural fiber with considerable fiber property variability, mills and other users do not need additional “challenges” when the bale arrives. Major types of contaminants include plastic, rubber, grease and oil, apparel or other fabrics, and other materials. Pieces of plastic from ditch liners or irrigation tubing (polypipe) can be gathered with the cotton during harvesting and become a source of contamination. Trash from adjacent urban or farmstead areas (plastic bags, sacks, etc.) can also be picked up during the stripper harvesting process. Pieces of old inner tubes or tires can also be a source of contamination. Grease can be derived from poor handling of grease guns, cartridges, etc., which should be avoided. Hydraulic fluid leaks, and other similar problems can contribute to fiber impurities. Grease rags have been noted as another source of contamination. Make sure these do not get mixed into the moduled cotton. Do not use acrylic or permanent paints for marking modules or bales. A Cotton Incorporated licensed sprayable product called Brand-A-Bale is the preferred choice. Module covers are also potential contamination sources. Do not use hay baling twine for module cover tie downs. It is important to use a 100 percent cotton rope, without running it through the module. If plastic module covers are used, watch the ends closely and repair when frayed or worn.

# 2007 HIGH PLAINS COTTON HARVEST-AID DECISION TABLE

**NOT ALL TREATMENTS ARE EQUALLY EFFECTIVE**

**RATES LISTED ARE UNITS OF PRODUCT PER ACRE**

| CROP CONDITION | DRY TEMPERATURES GREATER THAN 80° (0-3 DAYS AFTER TREATMENT) | DRY TEMPERATURES LESS THAN 80° (0-3 DAYS AFTER TREATMENT) | WET TEMPERATURES LESS THAN 75° (0-3 DAYS AFTER TREATMENT) |
|---|---|---|---|
| **HEIGHT:** Short 12-14 inches<br><br>**YIELD:** up to 400 lb/acre | Gramoxone Inteon 8-16 oz[1] | Gramoxone Inteon 8-16 oz[1] | Gramoxone Inteon 8-16 oz[1] |
| | Firestorm 5.3-10.7 oz[1] | Firestorm 5.3-10.7 oz[1] | Firestorm 5.3-10.7 oz[1] |
| | Gramoxone Inteon 4-8 oz followed by (FB) Gramoxone Inteon up to 48 oz total[2] | Gramoxone Inteon 8-12 oz FB Gramoxone Inteon up to 48 oz total[2] | Gramoxone Inteon 8-12 oz FB Gramoxone Inteon up to 48 oz total[2] |
| | Firestorm 2.6-5.3 oz FB Firestorm up to 21 oz total[3] | Firestorm 2.6-5.3 oz FB Firestorm up to 21 oz total[3] | Firestorm 2.6-5.3 oz FB Firestorm up to 21 oz total[3] |
| | Gramoxone Inteon 6-10 oz + defoliant/desiccant[4] | Gramoxone Inteon 8-12 oz + defoliant/desiccant[4] | Gramoxone Inteon 10-24 oz + defoliant/desiccant[4] |
| | Firestorm 4-6.7 oz + defoliant/desiccant[4] | Firestorm oz 5.3-8 oz + defoliant/desiccant[4] | Firestorm 6.7-16 oz + defoliant/desiccant[4] |
| | Ginstar 6-8 oz banded | Ginstar 8 oz banded | Ginstar 8-10 oz banded |
| | Aim EC 1 oz + COC with or without defoliant/desiccant | Aim EC 1 oz + COC with or without defoliant/desiccant | Aim EC 1 oz + COC with or without defoliant/desiccant |
| | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] |
| | ET 1.5-2 oz + COC with or without defoliant/desiccant | ET 1.5-2 oz + COC with or without defoliant/desiccant | ET 1.5-2 oz + COC with or without defoliant/desiccant |
| | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] |
| | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant |
| | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] |
| | Resource 6-8 oz + COC FB 4-6 oz + COC[5] | Resource 6-8 oz + COC FB 4-6 oz + COC[5] | Resource 6-8 oz + COC FB 4-6 oz + COC[5] |

# 2007 HIGH PLAINS COTTON HARVEST-AID DECISION TABLE (continued)

**NOT ALL TREATMENTS ARE EQUALLY EFFECTIVE**

**RATES LISTED ARE UNITS OF PRODUCT PER ACRE**

| CROP CONDITION | DRY TEMPERATURES GREATER THAN 80° (0-3 DAYS AFTER TREATMENT) | DRY TEMPERATURES LESS THAN 80° (0-3 DAYS AFTER TREATMENT) | WET TEMPERATURES LESS THAN 75° (0-3 DAYS AFTER TREATMENT) |
|---|---|---|---|
| **HEIGHT:** Medium 15-24 inches<br>**YIELD:** 400+ lb/acre | **FOR TREATMENTS LISTED BELOW, A SEQUENTIAL APPLICATION OF PARAQUAT (OR OTHER DESICCANT ACTIVITY PRODUCT) 10-14 DAYS AFTER INITIAL TREATMENT WILL LIKELY BE NECESSARY TO SUFFICIENTLY CONDITION CROP** | | |
| | Gramoxone Inteon 6-10 oz + defoliant/desiccant[4] | Gramoxone Inteon 8-12 oz + defoliant/desiccant[4] | Gramoxone Inteon 10-24 oz + defoliant/desiccant[4] |
| | Firestorm 4-6.7 oz + defoliant/desiccant[4] | Firestorm oz 5.3-8 oz + defoliant/desiccant[4] | Firestorm 6.7-16 oz + defoliant/desiccant[4] |
| | Gramoxone Inteon 4-8 oz followed by (FB) Gramoxone Inteon up to 48 oz total[2] | Gramoxone Inteon 6-8 oz FB Gramoxone Inteon up to 48 oz total[2] | – |
| | Firestorm 2.6-5.3 oz FB Firestorm up to 21 oz total[3] | Firestorm 4-5.3 oz FB Firestorm up to 21 oz total[3] | – |
| | Ginstar 6-8 oz | Ginstar 8 oz | Ginstar 8-10 oz |
| | Aim EC 1 oz + COC + defoliant/desiccant | Aim EC 1 oz + COC + defoliant/desiccant | Aim EC 1 oz + COC + defoliant/desiccant |
| | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] | Aim EC 1 oz + COC FB Aim EC 1 oz + COC[5] |
| | ET 1.5-2 oz + COC with or without defoliant/desiccant | ET 1.5-2 oz + COC with or without defoliant/desiccant | ET 1.5-2 oz + COC with or without defoliant/desiccant |
| | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] | ET 1.5-2 oz + COC FB ET 1.5-2 oz + COC[5] |
| | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant | Blizzard 0.5-0.6 oz + COC with or without defoliant/desiccant |
| | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] | Blizzard 0.5-0.6 oz + COC FB Blizzard 0.5-0.6 oz + COC[5] |
| | Resource 6-8 oz + COC FB 4-6 oz + COC[5] | Resource 6-8 oz + COC FB 4-6 oz + COC[5] | Resource 6-8 oz + COC FB 4-6 oz + COC[5] |
| | Prep 16 oz + Ginstar 3-5 oz | Prep 16-21 oz[6] + Ginstar 3-5 oz | Prep 21 oz[6] + Ginstar 3-5 oz |
| | Prep 16-21 oz + Def/Folex 8-16 oz | Prep 16-21 oz[6] + Def/Folex 16 oz | Prep 21 oz[6] + Def/Folex 16 oz |
| | Prep 16-21 oz + Aim EC 1 oz + COC or + Blizzard 0.5-0.6 oz + COC or + ET 1.5 oz + COC or + Resource 6-8 oz[5] + COC | Prep 16-21 oz[4] + Aim EC 1 oz + COC or + Blizzard 0.5-0.6 oz + COC or + ET 1.5 oz + COC or + Resource 6-8 oz[5] + COC | Prep 21 oz[4] + Aim EC 1 oz + COC or + Blizzard 0.5-0.5 oz + COC or + ET 1.5 oz + COC or + Resource 6-8 oz[5] + COC |
| | Finish 6 Pro 21 oz + defoliant (Def/Folex 8 oz or Ginstar 3-5 oz) | Finish 6 Pro 21-32 oz[6] (defoliant may be required) | Finish 6 Pro 21-42 oz[6] (defoliant may be required) |
| | FirstPick 3 pts + Ginstar 3 oz | FirstPick 3-4 pts[6] + Ginstar 5 oz | FirstPick 4 pts[6] + Ginstar 6-8 oz |

# 2007 HIGH PLAINS COTTON HARVEST-AID DECISION TABLE (continued)

**NOT ALL TREATMENTS ARE EQUALLY EFFECTIVE**

**RATES LISTED ARE UNITS OF PRODUCT PER ACRE**

| CROP CONDITION | DRY TEMPERATURES GREATER THAN 80° (0-3 DAYS AFTER TREATMENT) | DRY TEMPERATURES LESS THAN 80° (0-3 DAYS AFTER TREATMENT) | WET TEMPERATURES LESS THAN 75° (0-3 DAYS AFTER TREATMENT) |
|---|---|---|---|
| | **FOR TREATMENTS LISTED BELOW, A SEQUENTIAL APPLICATION OF PARAQUAT (OR OTHER DESICCANT ACTIVITY PRODUCT) 10-14 DAYS AFTER INITIAL TREATMENT WILL LIKELY BE NECESSARY TO SUFFICIENTLY CONDITION CROP** | | |
| **HEIGHT:**<br>Greater than 24 inches<br><br>**YIELD:**<br>800+ lb/acre | Prep 21 oz<br>+ Def/Folex 8-16 oz | Prep 21 oz<br>+ Def/Folex 16 oz | Prep 21-28 oz[6]<br>+ Def/Folex 16 oz |
| | Finish 6 Pro 21 oz<br>+ defoliant (Def/Folex 8 oz or Ginstar 3-5 oz) | Finish 6 Pro 21-32 oz[6]<br>+ defoliant (Def/Folex 8-10 oz or Ginstar 4-6 oz) | Finish 6 Pro 32-42 oz[6]<br>+ defoliant (Def/Folex 8-10 oz or Ginstar 6-8 oz) |
| | Finish 6 Pro 21 oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Finish 6 Pro 21-32[6] oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Finish 6 Pro 32-42[6] oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC |
| | Prep 21 oz + Ginstar 3-5 oz | Prep 21 oz + Ginstar 4-6 oz | Prep 21-28[6] oz + Ginstar 6-8 oz |
| | Prep 21 oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Prep 21 oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Prep 21-28[6] oz<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC |
| | FirstPick 3-4pts<br>+ Ginstar 3-5 oz | FirstPick 4-5 pts[6]<br>+ Ginstar 6-8 oz | FirstPick 6-7pts[6]<br>+ Ginstar 6-8 oz |
| | FirstPick 3-4 pts<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | FirstPick 4-5 pts[6]<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | FirstPick 6-7 pts[6]<br>+ Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC |
| | Ginstar 6-8 oz | Ginstar 8 oz | Ginstar 8-10 oz |
| | **CONDITIONING TREATMENT ONLY**<br>(Apply after daily heat units drop below 5, but 7 days before average first killing freeze date) | | |
| **LATE MATURING** | Gramoxone Inteon 4-8 oz | Gramoxone Inteon 6-12 oz | Gramoxone Inteon 10-16 oz |
| | Firestorm 2.6-5.3 oz[1] | Firestorm 4-8 oz[1] | Firestorm 6.7-10.7 oz[1] |
| | Prep 21-24 oz | Prep 21-32 oz[6] | Prep 32-42 oz[6] |
| | Prep 21-24 oz<br>+ Def/Folex 8 oz<br>or + Ginstar 8 oz<br>or + Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Prep 21-32 oz[6]<br>+ Def/Folex 8 oz<br>or + Ginstar 8 oz<br>or + Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC | Prep 21-32 oz[6]<br>+ Def/Folex 16 oz<br>or + Ginstar 8-16 oz<br>or + Aim EC 1 oz + COC<br>or + Blizzard 0.5-0.6 oz + COC<br>or + ET 1.5 oz + COC<br>or + Resource 6-8 oz[5] + COC |

## FOOTNOTES

FB=Followed by

[1] - Use on cotton with natural leaf shed. High rates can cause green, healthy leaves to stick. Always use a non-ionic surfactant when applying paraquat-based products (Gramoxone Inteon/Firestorm). There is some concern for the single high dose rate on hairy-leaf cotton varieties. Poor leaf grades may be obtained. Make sure the cotton has 80% open bolls at application, use enough paraquat to completely kill all foliage, then stripper harvest only when leaves are dry enough to "crunch" when crushed by hand. Avoid stripper harvesting moist, dead leaves or high leaf grades may be encountered.

[2] - No more than 48 oz/acre total of Gramoxone Inteon may be applied (in up to 3 multiple applications) in one season based on the Texas Special Local Need 24c label. The need for and rate of Gramoxone Inteon in a second application will depend upon green leaves remaining. Use higher rates if regrowth is excessive.

[3] - No more than 21oz/acre total of Firestorm may be applied (in up to 4 multiple applications) in one season based on the current label. The need for and rate of Firestorm in a second application will depend upon green leaves remaining. Use higher rates if regrowth is excessive.

[4] - Tankmix partners with Gramoxone Inteon and Firestorm can include sodium chlorate, Def/Folex, Aim, Blizzard, ET, and Resource..

[5] - No more than; 3.2 oz/acre total of Aim 2EC, 1.25 oz/acre total of Blizzard, 5.5 oz/acre total (in no more than 2 applications) of ET, and 14 oz/acre (in no more than 2 applications with a maximum of 8 oz/acre per single application) of Resource may be applied during the growing season.

[6] - Ethephon-based product (such as Finish 6 Pro, FirstPick, Prep, SuperBoll, Boll'd, Ethephon 6) activity is determined by rate and temperature. At lower temperatures, boll opening response can be enhanced by increasing rate.

## Conversion Table for Gramoxone Inteon and Firestorm for Equivalent Paraquat Active Ingredient Rates

| Paraquat (Active Ingredient) Lb/Acre | GRAMOXONE INTEON (2 LB/GAL) | | FIRESTORM (3 LB/GAL) | |
|---|---|---|---|---|
| | Product Oz / Acre | Approximate Acres/Gal | Product Oz / Acre | Approximate Acres/Gal |
| 0.0625 | 4 | 32 | 2.6 | 48 |
| 0.0938 | 6 | 21.3 | 4 | 32 |
| 0.1250 | 8 | 16 | 5.3 | 24 |
| 0.1563 | 10 | 12.8 | 6.7 | 19 |
| 0.1870 | 12 | 10.7 | 8 | 16 |
| 0.2500 | 16 | 8 | 10.7 | 12 |
| 0.3750 | 24 | 5.3 | 16 | 8 |
| 0.5000 | 32 | 4 | 21.3* | 6 |
| 0.7500 | 48 | 2.7 | --- | --- |

*Denotes current maximum seasonal use rate for Firestorm as a cotton harvest aid.