General Situation

Scattered showers last week helped some places with moisture needed for planting wheat and other small grains. Several grain sorghum fields have been harvested and others are waiting for a combine. Cotton has been popping open and some fields will be ready for harvest aid applications in the near future.

Harvest Aids

The following is a condensed version (not a complete version) of the 2007 High Plains and Northern Rolling Plains Cotton Harvest-Aid Guide by Dr. Randy Boman, Dr. Mark Kelley, Dr. Wayne Keeling, Dr. Alan Brashears, and Dr. Todd Baughman. The entire publication can be found at http://lubbock.tamu.edu/ under the What’s New Section.

FACTORS AFFECTING PERFORMANCE
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° 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
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.

Nodes above cracked boll (NACB) is a tool that can be used to time harvest aid application (Figure 1). 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. 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.

**HARVEST-AID CHEMICAL TYPES**

Harvest aids are basically classed in three categories – desiccants, defoliants, and boll openers.

**Desiccants**

- 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.
- **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 the online publication.
- 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 nonionic 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.

**Defoliants**

- 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.
- For 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.
- 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, that cause disruption of cell membranes, which in turn triggers increased ethylene in leaves.
- **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**

- 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 cyanilide and AMADS, respectively) enhance boll opening to allow for more timely harvesting of the crop.
- 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.

- 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. Etéphén 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 dent 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."

- A followup application of paraquat (or other product with desiccant activity) is generally required to sufficiently condition the crop for stripper harvest.

APPLICATION CONSIDERATIONS

- 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.

- 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. 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.

- Avoid applying on windy days to reduce the hazard of spray drift to nontarget vegetation.

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. Etéphén-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 (800 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.

Figure 1. Determining nodes above cracked boll.

From the uppermost 1st position cracked boll on the plant, count the mainstem nodes above it to the uppermost harvestable 1st position boll. Sample at least 40 plants across the field, then average.

Uppermost harvestable 1st position boll
Node 4 (above cracked boll)
Count as node 1

Uppermost 1st position cracked boll
2nd position boll (do not count)
1st position boll

Vegetative branch

Figure 2. Potential yield loss based on NACB method.

Potential yield loss* 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).

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