Preparing For Harvest

By **Michael Bange** (CSIRO)

Acknowledgements: Sandra Williams, Greg Constable, Stuart Gordon, Rob Long, Geoff Naylor and Rene van der Sluijs (CSIRO)

The key to effective defoliation

Effective cutout

Cutout is when the crop ceases to produce new fruiting sites. Timing of cutout must consider opportunity for further fruit production (yield) and potential losses in fibre quality and harvesting difficulties. The cutout date should aim to optimise yield and quality allowing squares and bolls on the plant to mature and open, enabling harvest prior to cool/wet weather.

Management tips

During flowering monitor cutout at least weekly using the Nodes Above White Flower (NAWF) technique. NAWF = 4 is generally the accepted time of cutout.

Use the CottASSIST Crop Development Tool to assist you to track your crop's rate of cutout compared with the optimal rate.

Crops approaching cutout too rapidly are stressed (either not enough water or nutrition or carrying a very high fruit load). So use a strategy to provide new growth such as irrigation or nutrition.

Consider how much time is left in the season. This can be done by estimating the date of the last effective flower (See Table 1). This can be determined through the CottASSIST Last Effective Flower Tool. This tool can be used to select your own data using your nearest weather station.

Crops approaching cutout too slowly can indicate that there has been a loss of fruit and/or plenty of water and nutrition. These crops should be monitored to determine if a growth regulant is necessary. Use the CottASSIST Crop Development Tool to check your VGR (Vegetative Growth Rate). Refer to Chapter 6 – Using Mepiquat Chloride.

BEST PRACTICE

- The key management considerations for optimising fibre quality are variety selection and avoiding crop stress. So good water and fertiliser management is critical. Producing poor quality fibre can lead to significant price discounts.
- Any management which delays maturity can lead to reduced fibre micronaire, and should be avoided where possible.

TABLE 1:
Average dates for the last effective flower for various locations for different times when crops are expected to finish. These have been calculated by the CottASSIST Last Effective Flower Tool (www.CottASSIST.cottoncrc.org.au) using historical climate data since 1957.

Average target date of your last effective flower					
Town	**Date when you want your crop to be finished (date of last harvestable boll)**				
	1st Mar	**15th Mar**	**1st Apr**	**15th Apr**	**1st May**
Jerilderie	30th Dec	11th Jan	22nd Jan	30th Jan	5th Feb
Griffith	31st Dec	12th Jan	24th Jan	31st Jan	7th Feb
Hillston	5th Jan	17th Jan	29th Jan	5th Feb	12th Feb
Warren	6th Jan	18th Jan	29th Jan	6th Feb	13th Feb
Bourke	13th Jan	25th Jan	6th Feb	15th Feb	22nd Feb
Walgett	11th Jan	22nd Jan	4th Feb	13th Feb	20th Feb
Wee Waa	8th Jan	20th Jan	2nd Feb	10th Feb	18th Feb
Gunnedah	4th Jan	16th Jan	29th Jan	6th Feb	14th Feb
Spring Ridge	31st Dec	12th Jan	24th Jan	1st Feb	9th Feb
Moree	8th Jan	20th Jan	2nd Feb	11th Feb	20th Feb
Mungindi	11th Jan	23rd Jan	5th Feb	14th Feb	22nd Feb
St George	12th Jan	24th Jan	6th Feb	15th Feb	23rd Feb
Goondiwindi	8th Jan	20th Jan	2nd Feb	11th Feb	19th Feb
Dalby	2nd Jan	14th Jan	28th Jan	6th Feb	15th Feb
Theodore	9th Jan	21st Jan	5th Feb	15th Feb	25th Feb
Emerald	11th Jan	24th Jan	7th Feb	18th Feb	28th Feb

Season length

Season length is another consideration that effects defoliation and harvest. Short growing seasons as experienced in southern & eastern growing regions should consider sowing as early as feasibly possible to avoid crops maturing and being harvested in cold and wet conditions. Sowing too early can however increase risk of poor seed germination and crop establishment.

Ceasing crop growth for a timely harvest

Late flowering and especially regrowth will cause fibre quality problems directly which will be reflected in reduced micronaire and increased neps, and indirectly with poorer grades. Delayed harvests also expose clean lint to increased chances of weathering. Humid conditions or rainfall increases microbial damage thereby potentially reducing colour grades. Poor and untimely defoliation can have a significant impact on fibre maturity as well as the amount of leaf trash.

- Management considerations from open boll to harvest include:
- Appropriate irrigation management for finishing the crop and avoiding regrowth.
- Managing aphid and whitefly infestations to avoid sticky cotton.

- Accurately determining crop maturity.
- Ensuring timeliness of harvest operations to avoid wet weather.
- Effective application of harvest aids.

A perfect system to attain the highest quality cotton would be to have a field with 70-80% mature bolls, generated from uniform flowering and boll retention resulting in an abrupt cutout that had ample water and nutrition to meet only those requirements of the fruit present at cutout. Leaves would have matured naturally and allowed for easy defoliation at an appropriate time when temperatures were warm. The crop would be ready to harvest when the chances of rainfall were small.

Irrigation management for finishing the crop

Crop management to synchronise crop maturity dates and harvesting operations with climate and weather is one aspect of timeliness. Excess nitrogen rates (see sowing to first flower chapter of FibrePAK) or events which cause late regrowth (e.g. excess soil moisture at harvest) can interfere with defoliation practices and picking. Delayed growth may also mean that fibre development may also occur in cooler weather (reducing fibre maturity, lowering micronaire and increasing neps).

Unnecessary and late season growth also supports late season insects which can damage yield and quality.In wet or humid weather leafy crops may also contribute to boll rot.

Timing of last irrigation is a balance between ensuring (1) there is enough moisture to allow the growth and maturity of harvestable bolls, and (2) fields are dry enough to assist defoliation, limit regrowth, and minimise picking delays and soil compaction. The moisture required for late crop growth is related to the time of defoliation. The broad aim is to plan to manage irrigations effectively to finish the crop and to limit regrowth by having soil moisture levels to refill points by defoliation.

Determining end of season crop water requirements (taken from IPM guidelines)

End of season water requirements can be estimated from the date of the last effective flower (which is when the Nodes Above White Flower (NAWF) measurement is equal to 4). The last harvestable bolls take 600 to 650 degree days to reach crop maturity. Therefore for crops to be defoliated towards the end of March, the last effective flower needs to occur in the last week of January. Crop water use needs to be considered for this period. At the time of first open boll, crop water use may be 5-7 mm per day and may decline to around 4 mm per day prior to defoliation.

Factors to consider:

- Days to defoliation;
- Boll maturity;
- Crop water use;
- Plant available water – ability to extract water below normal refill point; and,
- Soil moisture objective at defoliation.

Days to defoliation

(General example – need to generate values for your own district)

- Defoliate when Nodes Above Cracked Boll (NACB) is equal to 4.
- Takes 42 degree days, around 3 days (up to 4 days in cooler regions) for each new boll to open on each fruiting branch.
- (Total NACB – 4) x 3 = days to defoliation.
- Aim to be at or close to refill point at time of defoliation.

Crop maturity is monitored to avoid early crop cessation

To determine crop maturity monitor plants that are representative of the crop.

Methods include:

- % **bolls open –** Crops can be safely defoliated after 60-65% of the bolls are open. This method is simple and works well in crops with regular distribution of fruit.
- **NACB (Nodes above cracked boll) –** In most situations 4 NACB equates to the time when the crop has 60% bolls open. This is a useful methodology on crops that are uniform in growth, and is less time consuming than % open bolls.
- **Boll cutting –** The easiest and probably the most effective method to determine if bolls are mature or immature. It can be used effectively even when crops are not uniform (e.g. tipped out plant, gappy stands). Bolls are mature when: they become difficult to cut with a knife; the seed is well developed (not gelatinous) and the seed coat has turned brown (see Figure 1); and when the fibre is pulled from the boll it is stringy (moist but not watery).

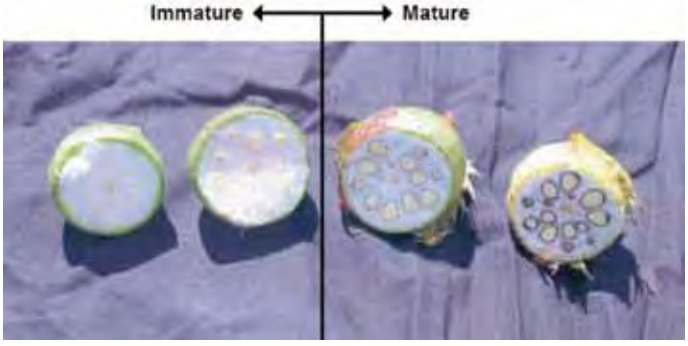
See also timing of harvest aids following.

Whitefly and aphid infestations are monitored and managed to avoid sticky cotton

A significant proportion of all cases of stickiness are attributable to honeydew exudates of the silverleaf whitefly (Bemisia tabaci B-biotype) (SLW) and the cotton aphid (Aphis gossypii). The sugar exudates from these insects lead to significant problems in the spinning mill.

Presence of honeydew on the surface of cotton late in the

FIGURE 1:
Bolls that are mature have seed coats that are turning brown. (Photo: CSD)



season can also contribute to reductions in grade as it provides a substrate for sooty moulds and other fungal growth. In humid conditions the growth of fungal spores along with honeydew can increase the grey colour of the lint.

SLW and aphids prefer to feed on the under surface of the leaf allowing the small transparent droplets of honeydew to fall to leaves and open bolls below. The level of contamination by honeydew is directly dependant on the numbers and species of insects present. Control of these pests is especially important once bolls start to open.

For more information on managing these pests see the Cotton Pest Management Guide.

Timeliness of harvest operation

Cotton that is severely damaged from weather is also undesirable in textile production because the lint surface has deteriorated and this is perceived to have dye uptake problems. It also can increase the roughness of the fibre which alters its frictional properties and thus how the fibre performs in the spinning mill.

As cotton weathers it loses reflectance, becoming grey due to moisture from both humidity and rain, exposure to ultraviolet radiation (UV) and from fungi and microbes that grow on the lint or wash off the leaves. Damage to the fibre will reduce micronaire as the fibre surface becomes rough retarding air movement in the micronaire chamber. Weathering will also reduce fibre strength making fibres susceptible to breakage during the ginning process, reducing length and increasing short fibre content leading to issues in yarn production.

When a boll opens under humid conditions microbes begin to feed on the sugars on the surface of the fibre and stain the lint. Under very humid conditions fungi can multiply on the lint causing 'hard' or 'grey locked' bolls which can reduce both quality and yield.

If bolls are opened prematurely by frost often it has a yellow colour that varies with intensity of the frost. Injury to moist boll walls as a result of frost damage releases gossypol which stains the cotton yellow.

A grower should examine their harvest capacity, regional weather patterns, and have monitored their crop development to avoid excessive weathering.

Specific considerations include:

- Time harvest to avoid excessive rainfall once bolls are open. Tools to assess rainfall frequency include: Rainman (http://www.daff..qld.gov.au/26-15734.htm http://www.bom.gov.au/climate/averages/
- Plan to have the crop defoliated before first frost. See Table 2 or use the last effective flower tool on the CottASSIST website which can be used to identify the timing of first frost for your locality.

Effective application of harvest aids

Defoliation induces leaf abscission which is the formation of a break in the cellular structure joining the leaf to the stem allowing the leaf to fall off. Leaf removal is critical for reducing the amount of leaf trash in machine harvesters. These chemicals allow timely and efficient harvest of the lint to reduce quality losses from weathering and leaf stain from excess leaf trash. Boll opening is also accelerated by defoliation as removal of leaves exposes bolls to more direct sunlight, promoting increase temperatures for maturation, and drying and cracking of the boll walls.

TABLE 2:
Dates of first and last frost for cotton production
(Source: http://www.longpaddock.qld.gov.au/silo/)

Region	Years of climate data	Average date of first frost	Date of earliest frost recorded
Emerald	111	9 Jun	23 Apr
Dalby	111	26 May	17 Apr
St George	43	7 Jun	7 May
Goondiwindi	107	2 Jun	23 Apr
Moree	111	28 May	12 Apr
Narrabri	43	25 May	27 Apr
Gunnedah	62	22 May	11 Mar
Bourke	43	12 Jun	10 May
Warren	43	27 May	27 Apr
Hillston	43	17 May	1 Apr

Application of harvest aids are determined by: the timing, the type of chemical used, and the rates applied. The effectiveness of harvest aids is dependent on: uniformity of plant growth, weather conditions, spray coverage, and adsorption and translocation of the chemical by the plant. Optimum timing of harvest aids must strike a balance between further boll development and potential losses from adverse weather and the inclusion of immature fibre which can lower micronaire and increase neps (Figure 2). Avoiding regrowth resulting from residual nitrogen and moisture in the soil will also contribute to harvest aid effectiveness, as regrowth plants have high levels of hormones that can interfere with defoliation.

Types of harvest aids

The categories of harvest-aid chemicals include herbicidal and hormonal defoliants, boll openers, and desiccants each with a different mode of action:

Defoliants (Thidiazuron, Diuron, Dimethipin) – All defoliants have a common mode of action to remove leaves. They increase the ethylene concentration in leaves by reducing the hormone auxin and/or enhancing ethylene production. Dimethipin alters the concentration of ethylene by reducing the amount of water in the leaf stimulating ethylene production. This change in ethylene concentration triggers separation in the abscission zone at the base of the petiole (leaf stalk). Chemical defoliant

Neil's Parts Australia

COTTON PICKER PARTS FOR JOHN DEERE® AND CASE-IH® PICKERS

New Parts

R.M.KING COMPANY™

Proudly manufacturing aftermarket Picker parts at the same or better quality as the OEM product!

HEAD GEARBOXES

MOISTENER COLUMNS PRO 12

POLY NOSE CONES

POLY PRESSURE DOOR COVERS

Spindle Grease & Cleaner

SPINDLE GREASE

SPINDLE CLEANER

WN-627-5000 20 Litre
WN-627-5522 208 Litre

WN-905GD-4001 181kg Drum
WN-905GD-7717 1090kg Shuttle

Services

WE HAVE AVAILABLE:

- ✓ EXCHANGE DOFFER STACKS
- ✓ REBUILT BARS

WE CAN DO:

- ✓ DOFFER GRINDS
- ✓ PICKER HEAD REBUILDS

Rebuilt Parts - Like New but without the expense

And a whole lot more ... Including a huge range of New, Used & Rebuilt Tractor Parts!

Wrecking - Buy Used Parts and Save even more!

CIH 2055 | CIH 2555 | CIH 2555 | JD 9960 | JD 9965 | JD 9970 | JD 9976

All of our parts (including used) have a '30 day no questions asked return policy' and a 'one year limited warranty'

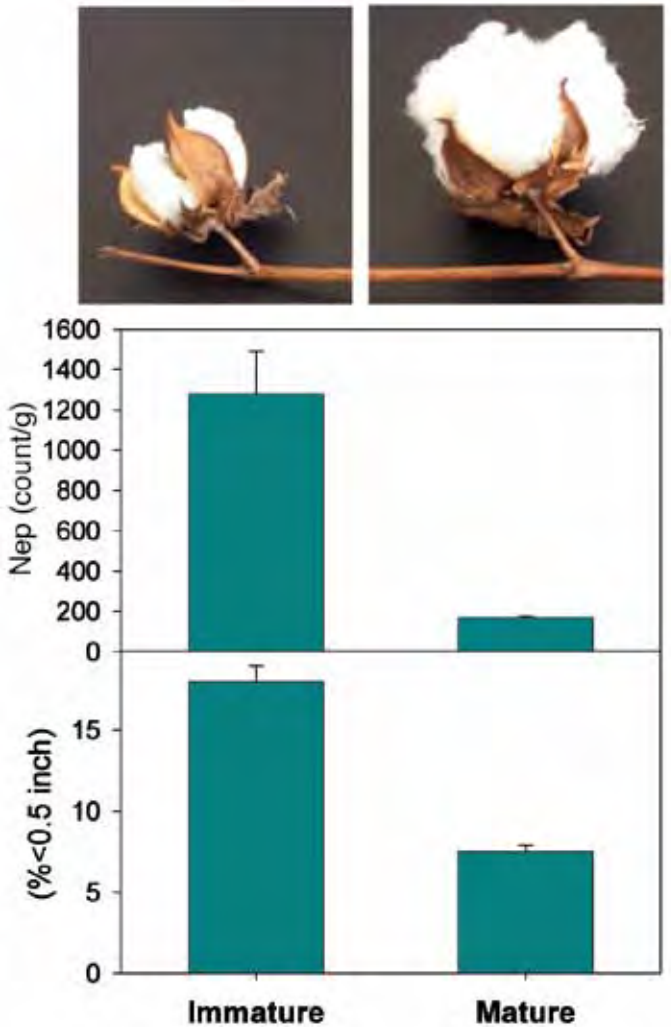
Providing a better deal for Farmers for over 40 years!

1800 463 457 ← **Freecall Australia Wide**
Including calls from Mobile Phones!

www.neils.com.au

AH: 0448 090 384 & 0448 113 600

FIGURE 2:
Pursuing late bolls may put fibre quality at risk. Un-fluffed immature bolls contribute little to yield but significantly increase neps and short fibres. (Rob Long, CSIRO)



enters leaves through the stomates (minor route) or through the leaf cuticle (major route). Hormonal defoliants are applied to reduce auxin and/or enhance ethylene production, while herbicide defoliants injure or stress the plant into increasing ethylene production (similar to waterlogging or drought effects). If herbicide defoliants are applied at too high rates the plant material may die before releasing enough ethylene to cause defoliation resulting instead in leaf desiccation (leaf death).

Boll openers/conditioners (Ethephon, Cyclanillide, Aminomthanane Dihydrogen Textraoxosulfate) – These chemicals specifically enhance ethylene production by providing a chemical precursor for the production of ethylene, which leads to quicker separation of boll walls (carpels).

Desiccants and herbicides (Sodium Chlorate, Magnesium Chlorate, Glyphosate, Diquat, Paraquat) – Desiccants are contact chemicals that cause disruption of leaf membrane integrity, leading to rapid loss of moisture, which produces a desiccated leaf. Desiccants should be avoided as they dry all plant parts (including stems) which can increase the trash content of harvested lint. Sometimes it is necessary to use desiccants if conditions do not enable the effective use of defoliants (e.g. very cold weather). Desiccants are also a reliable method to reduce leaf regrowth. High rates of some defoliants can act as desiccants.

Timing of the application of harvest aids

The type of defoliation product is unlikely to impact on fibre quality if timing is correct however, early defoliation can cause a significant reduction in all desirable fibre properties. Too early defoliation will increase the number of bolls (often from the top of the plant) harvested that have immature fibre with reduced fibre strength and micronaire. This may cause fibres to break during ginning lowering fibre length and uniformity and increasing short fibre content and neps. It is important to note that immature fibre will not allow for correct assessments of fibre strength using HVI.

Application of defoliations earlier than 60% of bolls open will reduce micronaire and increase neps. In crops that have non-uniform maturity it is advisable that there be no more than 29% immature bolls (of total boll number) that are defined as immature bolls using the boll cutting technique to avoid increasing neps.

Key issues for use of defoliants

- Ensure defoliation practices occur before the onset of frost.
- Aim to have soil moisture at refill points at defoliation. Severely water stressed crops will not allow defoliants to act effectively.
- If boll openers/conditioners are applied prior to boll maturation they may cause bolls to shed and reduce yield.
- The use of boll opener/conditioners should only be considered if the bolls that will be forced open are mature.
- Avoid application of defoliants when there is a risk of rainfall shortly after. Some defoliants are taken up slowly by the leaves and will wash off by rain, resulting in incomplete defoliation.
- To avoid regrowth issues it is prudent not to defoliate an area bigger than can confidently be harvested within 2 weeks.

Rate and chemical selection issues

- Varieties can sometimes differ in the needs for defoliation as they can differ in the quantity of wax on the leaf surface which affects harvest aid uptake, and plant hormone concentrations.
- Leaves most susceptible to defoliant are older leaves. Higher rates of defoliant will be needed for young healthy leaves. However, there is a chance that young leaves may 'freeze' on the plant if defoliant is applied in too warm weather.
- Cool temperatures, low humidity and water stress prior to defoliant application can increase the waxiness

and thickness of the leaf cuticle reducing the efficiency of chemical uptake. Wetting agents or spray adjuvants can assist with this problem.

- Because leaf drop requires production of enzymes, the speed with which a leaf falls off is highly dependant on temperature. There are different optimal temperatures for defoliant performance. Hormonal defoliants and boll conditioners have a higher optimal minimum temperature of around 18°C compared with herbicide defoliants that have optimal minimum temperatures ranging from 13 to 16°C. Higher rates are often needed to offset the effects of low temperatures.
- The defoliating effects of a chemical are usually complete 7 days after application.

Application issues

- Low humidity during application decreases uptake because chemicals dry rapidly on the leaf.
- For penetration of defoliants lower into the canopy consider using larger droplet size or directed sprays in the case of ground rig use. Use of spray adjuvants may decrease droplet sizes and this may work against chemical penetrating deeper into the canopy.
- Many growers use combinations of defoliants with different modes of action and multiple applications to enhance defoliation. Multiple applications are beneficial because leaves deep in the canopy can be covered fully.
- If increased waxiness of the leaves is suspected, applying the defoliant in warmer conditions can assist chemical penetration as the waxy layer is more pliable.

Refer to the Cotton Pest Management Guide and manufacturers details for specific chemical defoliation options and rates.

These guidelines have been extracted from FIBREpak – A Guide to Improving Australian Cotton Fibre Quality.

For more information the following resources and tools are available at https://www.mybmp.com.au/auth_user/grower_tools_and_resources.aspx

- **FIBREpak**
- **CottASSIST**
- **Cotton Pest Management Guide**
- ***my*BMP**