

# Harvesting & Delivering Uncontaminated Cotton

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## OH & S at harvest

It is vital that all contractors and farm staff go through a safety induction in cotton harvest. The key to managing farm safety during harvest is to involve all staff in identifying potential hazards and implement a plan to manage these safety risks. This process is equally important for contractors as well as farm staff.

Developing a set of procedures of how you would like the picking operation to progress will ensure that all involved are aware of correct and safe operation of equipment. The following are examples of procedures:

- Read and understand the operation manual and the basic safety procedures which are provided with the picker.
- Establish procedures and picking patterns and then train and re-train all staff/contractors on how picking machinery will be serviced and operated.
- Wearing appropriate clothing and using protective equipment where necessary can reduce the risk of an accident occurring.
- Keep windows and mirrors clean for good visibility.
- Keep all lights and alarms in proper working order.
- Ensure walkways and platforms are free of tools, debris or mud.
- Travel at safe speeds around ground staff and

## BEST PRACTICE

- Regular maintenance and correct set up of pickers must be conducted for a clean and effective harvest.
- Check tarp quality.
- Check moisture levels in modules.
- Come Clean Go Clean - Ensure farm hygiene practices are in place to avoid contamination, especially when constructing modules.

equipment and limit unnecessary traffic around pickers and builders

- Ensure everyone is out of danger way before emptying or moving a picker or plant.
- Emphasise 'look up and live' to avoid contact with overhead obstacles such as powerlines, trees or sheds.
- If work continues during the night, workers must take extra care and be aware of the position of other workers. Workers should wear reflective clothes or safety vests and audible warning sounds on machinery should be activated.

For further information on OH & S please refer to Chapter 26.

## Use of a properly maintained picker that is setup correctly

The two types of mechanical harvesting equipment are the Spindle picker, which is used to pick the bulk of the Australian crop, is a selective type harvester that uses rotating tapered, barbed spindles (Figure 1) to pull seedcotton from opened bolls into the machine. The other type of harvesting machine is the cotton stripper which is a non-selective, that uses brushes and bats to strip seed cotton from bolls. These harvesters are predominately used to harvest seed cotton from rain fed (dryland) cotton with shorter plant heights and lower yields but removes not only the well opened bolls but also the cracked, immature and unopened bolls along with the burrs (carpel walls), plant sticks, bark and other foreign matter. Stripper harvested seed cotton often increases ginning costs and results in lower turnout as well as lower grades.

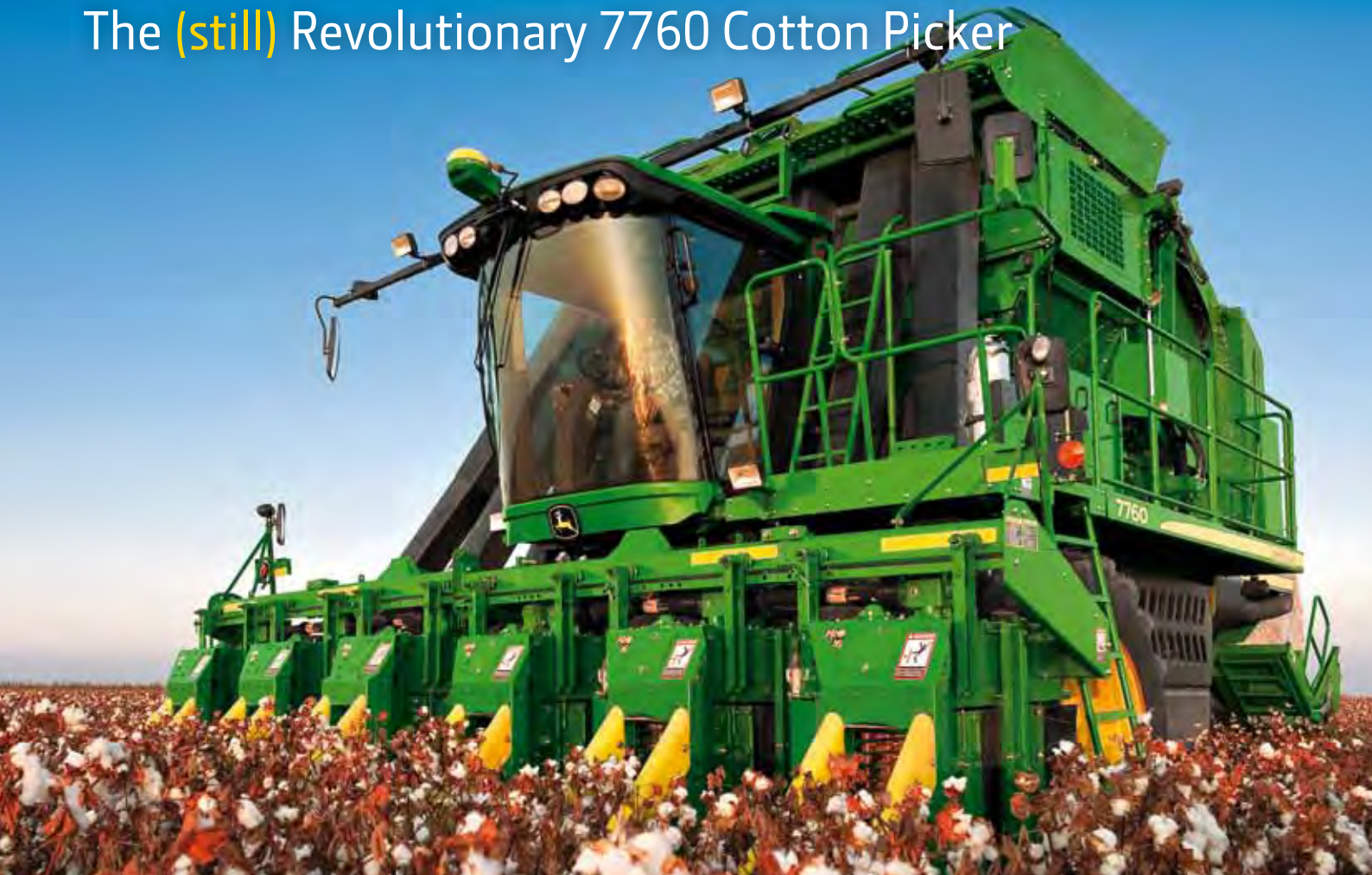
Generally agronomic practices that produce high quality uniform crops contribute to harvesting efficiency. Soil

**FIGURE 1:**

Spindle pickers require regular maintenance to operate at high efficiency.



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should be relatively dry in order to support the weight of the harvesting machinery and avoid unnecessary soil compaction. Row ends should be free of weeds and grass and should have a field border for turning and aligning the harvesters with the rows. Banks in drains should not be too steep an angle. Plant height should not exceed about 1.2 m for cotton that is to be picked and about 0.8 m for cotton that is to be stripped.

Spindle pickers are large and complex machines that are expensive to purchase costly to maintain and require precise setup, adjustment and trained and skilful operators to obtain the maximum yield and value per acre possible. Special care should be given to the spindles, moistener pads, doffers, bearings, bushings, and the cam track. Proper maintenance and correct setup of pickers will help to ensure a clean and effective pick. Your best source of information about picker maintenance and setup is your picker operator's manual.

Moisture is added to the spindles to keep them clean and to enhance the adherence of the fibre to the spindle and allow for its removal by the doffer. Spindles generally require less moisture in the morning than in the afternoon.

As Australian cotton is mainly picked by means of the spindle harvester, this chapter will focus mainly on this system. Many issues will however apply to both picked and stripped cotton harvesting systems.

#### Pre season maintenance includes:

A successful harvest requires a cotton harvester that is in good condition; even old harvesters can do an efficient job if they are in good mechanical condition. Special care should be given to the spindles, moistener pads, doffers, bearings, spindle bushings, and the cam track. Your best source of information about maintenance and setup is the operator's manual.

- Check and replace damaged tyres.
- Inflate tyres to the pressure specified before making any field adjustments.
- Ensure that row units are tilted as specified by machinery manufacturer.
- Replace bent, broken or worn spindles and ensure that all spindles are sharp and free of rust.
- Check spindle bushes for excessive wear.
- Ensure all spindles have similar length and diameter.
- Ensure all spindles turn when the row unit is rotating.
- Doffers need to be ground and reset properly as required. Replace when damaged.
- Check moisture pads, bar heights and grid bars. Moisture pads should wipe each spindle clean to remove plant juices (sap) that may cause spindle twist.
- Check cam track, roller, drum head and bar pivot stud for excessive wear.
- Check pressure doors for wear, bends, gap and alignment.
- Clean basket pre cleaners and picker basket top.



(Photo: Cotton Australia: Joanne Ambrose)

- Check hydraulic lines, components and air hoses for leaks.
- Ensure drive belts are adjusted correctly and universal joints in the drive train are lubricated and in good condition.
- Check condition of steps and handrails on harvester.

#### Daily setup and checks include:

Proper cleaning and servicing of the harvester before, during and after harvesting has been completed will result in better performance and lower the potential of fire.

- Check engine oil and coolant levels before starting engine of harvester for the first time in the morning.
- Picker heads should be greased when they are warm. Some systems also require light greasing every two to four hours throughout the day. Spin heads to remove excess grease and wash down if excess still remains.
- Ensure head heights are set correctly (too high and bolls are not harvested, too low and soil is collected).
- Ensure correct setting of pressure doors for crop conditions. Dented or worn doors cause inefficient picking. Adjust doors to allow efficient removal of lint but avoid excessive green boll and stem bark removal.
- Doffers need to be checked daily and throughout operation. Too much clearance leads to improper doffing and spindle twist in the lint while lack of adequate clearance leads to rapid abrasion of doffer plates by the spindles leading to presence of doffer pad specks (often not detected until textile manufacture).
- Spindles and bushes should be regularly checked for wear, especially the ones near the ground. Worn parts should be replaced.
- Spindles should be kept clean as dirty spindles cause spindle twist (wrap) and incomplete doffing resulting in excessive accumulation causing the unit air system to choke.
- Use a recommended spindle cleaner in conjunction with the correct nozzle output determined by existing conditions (especially if there is green leaf present on the plants).



- Perform regular cleaning, either using a broom, your hands or compressed air, of the picking air suction doors, basket or bale chamber. Dispose of fly cotton where it cannot contaminate the module.
- Adjust water volume correctly according to the time of day and picking conditions. Higher rates are usually needed in the middle of the day when conditions are drier.
- To avoid harvesting green bolls, pressure doors should be set to light to medium and all grid bars should be in position.

Templates are available in the Fibre Quality module in *myBMP* to help with pre-season and daily picker checks.

### Guidelines for module placement, construction, tarping and transport

Key considerations for module production to maintain quality are module placement, construction, tarping, storage and transportation to the gin. Another important consideration is ensuring personnel involved in module building are instructed and observe a sanitary workplace in terms of contamination. Workers should abide by the dictum that no unworn clothing, rags, papers, tools, non-cotton ropes, tarps (with exception of the module tarp), lunch bags etc. be left in and around the module making work site. In addition cotton is highly flammable and it is essential that workers do not smoke near cotton modules.

Typically harvesters with basket systems require module builders to produce conventional (traditional) modules that have a maximum size of 2.4 x 3.0 x 12 metres. These modules can weigh 12-16,000 kg which produce an average of 24 bales. In contrast harvesters that can build modules on board builds modules which weigh 2,000-2,600 kg which produce an average of 4 bales.

### Module placement

Incorrect placement of modules has the potential to contribute to significant losses caused by moisture damage as well as contributing to contamination. The following guidelines should be considered when choosing a site for module placement:

- Module pads should have enough space to allow easy access for the equipment and trucks.
- Located on a well-drained field road and avoiding areas where water accumulates.
- Surface of site free from gravel, rocks, stalks, and debris such as long grass or cotton stalks.
- Smooth, even and firm compacted surface that allows water to drain away.
- Accessible to transport and inspection in wet weather.
- Away from heavily travelled and dusty roads, and other possible sources of fire and vandalism.
- Clear of overhead obstructions, especially power lines.
- Build modules in a straight line which will assist the carrier to avoid misalignment of modules on the trailer that could cause an over-width load, breakage of the module and lost cotton.

- Ensure ample space around the module builder so that harvesting equipment, trucks and infield loaders have easy access.
- Module builders should not be elevated with blocks as this can create oversized and overweight modules.
- Only build module weights which are appropriate to the transportation system. Do not exceed 16 tons if chain beds are to be used, with flat top trucks able to handle more weight.

### Module construction

A module builder compacts seed-cotton to a density of about 190 kg/cubic m. A tighter module better sheds rainfall on the sides and less cotton is lost during storage, loading and hauling. The top of the module should be rounded to allow the top of the module when covered to shed water. In addition a well compacted module will help reduce freight costs to the gin.

Good communication is needed between module-builder operators, picker and boll buggy drivers to allow appropriate time for modules to be built and to avoid spillages. Cotton that is spilled from modules should be carefully added back into the module avoiding contamination whilst following strict OH & S guidelines.

A constant lookout for oil leaks on both cotton pickers and the module builders is needed to prevent contamination. Oil leaks on builders should be repaired as soon as they are noticed. Oil contaminated cotton needs to be removed from the module as soon as it is identified.

### Module tarping

Use of a high quality tarpaulin on modules is important to avoid moisture affecting quality as well as avoiding significant contamination of the cotton from the tarpaulin itself. Before using tarpaulins inspect them for holes, tears and frayed edges and that they repel water.

Tarpaulins should be chosen considering their tensile strength to avoid tearing, resisting puncturing and abrasion, adhesion of coatings, UV resistance, and cold crack temperature. If tarpaulins have seams they should be double stitched, with a minimum number of stitches. Centre seams (unless heat sealed) should be avoided as it is a potential weak point to allow water to enter the module. All these factors should be weighed up in light of the overall cost of the tarpaulin and its life expectancy. The tarpaulins should be kept in a dry, vermin free store to ensure their quality and longer life expectancy.

To avoid contamination and fibre quality losses tarpaulins need to be securely fastened to the module. For best performance of tie-down type module covers use all loops and grommets provided. Cotton rope is the most appropriate fastener to limit contamination and synthetic rope should never be used. Ensure rope has enough strength to endure strong winds. Belly ropes should be avoided if possible as they may break. A tarp should be large enough to cover at least half to two thirds of the modules on the ends.

### Module transportation

- Locate module tickets in the same location on each tarp, this will help when loading and allow for easy checking that each module has been tagged.
- Truck and trailer beds need to be cleaned prior to picking up the module (A rake should be provided).
- No loose cotton to be added to module when loading.
- All loads to be properly covered.
- Truck beds to be cleaned down after unloading (Come Clean – Go Clean).
- For specific details on regulations for module transportation go to [www.cottonaustralia.com.au](http://www.cottonaustralia.com.au) for the latest information.

### Keeping good module records

Identifying when and where each module is produced can help with producing better fibre quality outcomes as the grower can discuss with the ginner the quality of the cotton of each module and thus tailor the ginning process to suit. The grower can also use these records to better understand the variability that exists in fields to refine management practices for that particular field in subsequent seasons.

Each module should have a record (with a duplicate kept in a safe place), which includes the date and weather conditions when picked. Any records or numbers assigned to modules should be as permanent as possible. Permanent marker pens should be used on cards attached to modules in a sealable plastic bag.

If a module is suspected of having a contaminant, clearly identify it, and notify the gin when delivering the module of the potential problem.

### Round module pickers

The introduction of on board module building capacity on pickers (Figure 2) has offered opportunities to growers to undertake non-stop harvesting and eliminate in-field unloading to boll buggies and processing in module builders. This picking process may potentially save time, fuel, and labour and may allow simpler segregation of cotton of differing quality.

The round modules are covered with an engineered polyethylene film that both protects the seed cotton and provides compressive force to maintain the module density. As this harvester can harvest without stopping to unload the operator needs to decide where and when to drop the module that has been completed and being carried. Typically, the finished module is carried until it can be dropped on a turn-row. However if the yield is very high, or the row lengths are long, it may be necessary to drop the modules anywhere within the field. This action has no impact on the operation of the harvester, but stalks may puncture or tear the plastic wrap.

While management processes using these systems will differ and alleviate some of the issues discussed below many of the principles will, however, still apply.

### Module staging

As is the case with conventional modules incorrect placement of modules can contribute to losses caused by moisture damage as well as contributing to contamination. The modules must be picked up from where they were dropped in the field, and staged together for pickup. The most common system is a mast-type tractor mounted implement that holds the module with the axis parallel to the tractor rear axle. Because the round modules can weigh up to 2,600 kg's, a large tractor is required for staging.

- Transport speed of the tractor with a module on the handler should be kept to a safe speed to suit current conditions and not exceed 16 km/h (10 mph).
- When transporting modules through harvested rows, the module should be carried high enough to minimize contact with those rows.
- Gap between the underside of the module and the ground should be sufficient and never be less than 15 cm during module staging to prevent drag and tearing of underside of wrap.
- Modules should be staged only in well drained areas of bare soil, such as turn-rows. If the soil is wet, wheel slip by the truck can cause the loading chains to tear the plastic wrap.
- Modules should be staged on a high flat surface. Staging on well defined flat driveways or a flat disked surface is optimal. Modules will take the shape of the surface they are placed on. Setting on beds or uneven surfaces requires digging into the ground with the module truck chain to safely get under the entire surface of the module.
- Avoid placing the module on cotton stalks, as the movement of the modules on the stalks can puncture the plastic wrap. If possible, avoid staging in areas where the truck cannot access the modules if rain occurs.
- When staging round modules together for transport or for storage at the gin, lift the module 30 cm or more above the ground. A lower position can result in stalks tearing the exposed wrap on the bottom.
- When placing modules together for transport, a gap should be left between each module.
- Do not allow module ends to touch, as this will cause water to enter the modules rather than to run off down the ends. The modules should be aligned so that the centrelines are within a +/- 13 cm band. If not properly aligned, the wrap may be damaged by the sidewalls of the module truck.
- Stage round modules for transport as per transport operators required method. The two typical staging types are "Sausage" (end to end) and "Wagon Wheel" (at 90 deg from end to end). The "Wagon Wheel" is more common for loading by articulated loaders and transport by flat top trucks. The "Sausage" staging is for the more specialised self loading chain-bed trailers. However development of a self loading



trailer for Wagon Wheel loading is being pursued. Modules staged for sausage chain-bed module truck pickup must have gaps between 102 mm and 203 mm at module cores. Too little gap can cause tearing as modules travel up module truck incline due to interference with adjacent modules. Also, having module ends contacting each other during long-term storage can increase chances of mold growth. Gaps between modules allow ventilation.

- Significant wrap tears must be repaired in the field before module truck pickup to prevent further wrap damage and ginning problems.
- Loose outer tails must be secured with a high strength spray adhesive (3M 90) or lint bale repair tape.

### Round module transportation

**The Load Restraint Guide requires each module to be individually restrained.**

On open sided semi-trailers, the round bale modules can be loaded either 'wagon wheel' or 'sausage' configuration. From the point of view of managing the risk that the sides of individual round bale modules may bulge beyond the statutory load width of 2.5 metres once restraint straps are tensioned, the 'wagon wheel' option is the preferred loading configuration.

Caution: Round bale modules loaded on open sided flat-top trailers in the 'sausage' configuration are much more likely to expand beyond the trailer sides once restraint straps are tensioned.

If any section of a round bale module extends beyond the statutory maximum width of 2.5 metres when loaded on a flat-top trailer, then the entire load is deemed to be over-width. In this situation you may not be legally able to operate under an over-width notice due to the multiple number of round bales on the trailer determined as a 'divisible' load.

## Quality Issues

### Moistures considerations

Cotton that is picked wet will result in cotton being twisted on the spindle (spindle twist – roping that occurs when spindles are partially doffed) which may lead to seed cotton being more difficult to process in the gin. Moist cotton during the ginning process can also mean that excessive drying is needed which also causes fibre damage. The harvesting operation itself is also interrupted as picker doors are blocked more often when cotton is too moist and efficiency declines as a result of poor doffing efficiency, i.e. no flow out of the basket. Doffers and moisture pads on pickers can also be damaged.

Typically cotton is too moist for harvest at dawn in Australia but cotton can be picked well into the night provided relative humidity remains low. Moisture monitoring using moisture meters or dew point charts/calculators need to be used more frequently at each end of the day as the change in moisture can be quite abrupt,

e.g. moisture can increase abruptly from 4% to 6% within 10 minutes as night and dew point temperature fall rapidly. Harvesting seed-cotton in excess of 12% moisture is not recommended. Note: hand held moisture meters are usually  $\pm 1\%$  accurate.

If wet cotton is processed into a module in the field it will also increase the risk of the module self combusting or lowering the grade due to yellowing or spotting associated with fungal contamination.

Modules during storage on-farm and in the gin should be monitored every five to seven days for temperature rises. A rapid temperature rise of approximately 8 to 11 degrees Celsius or more in 5 to 7 days signifies a high moisture problem and that module should be ginned as soon as possible. Modules that have temperatures rising to 43 degrees Celsius need to be ginned immediately. The temperature of modules harvested at safe storage moistures will not increase more than 5.5 to 8 degrees in 5 to 7 days and will level off and cool down as storage period is extended.

### Assessing moisture content

Some rules of thumb to consider relating to moisture on cotton to be harvested include:

- If moisture is present on vehicles while harvesting it is most likely that the cotton is too wet.
- The seed should feel hard (cracks in your teeth)
- When a handful of cotton collected in the palm of your hand is squeezed into a ball and then released, the moisture content is acceptable if the seed cotton springs back to near its original size.
- If you can feel moisture on the cotton it is too wet. Seed cotton measured on a moisture meter should be less than 12%.
- Consider that machine picking can also add 2% moisture to seed cotton.
- The addition of green leaf will add moisture.
- A symptom of moist cotton is frequent blocked doors, throwing cotton out the front of the picking heads.
- If cotton is being expelled into the basket in dense blobs and is not fluffy it may be too moist.
- Suitable picking conditions late into the night are rare.
- Notify your ginner of modules that may be moist so that they may be ginned first, or at least monitored in the module yard.

**FIGURE 2.**

Round modules and small modules automatically made and discharged from pickers avoid to a large extent the problem of contamination, although contamination from tarps and coverings, which need to be removed before ginning, remains an issue. (Photo: John Deere)



### Round modules

Seed cotton moisture has always been an issue; however, there are some characteristics of round modules which highlight the need for diligent monitoring of seed cotton moisture:

- Round modules are smaller in size in comparison traditional modules which means that there will be less dilution of the cotton from across different picking times and moistures. The last round module picked each night will have significantly higher moisture than those picked in the middle of the day. From a ginners perspective this is an issue as they are unable to respond to rapidly changing moisture levels to gin efficiently.
- As there is less surface on each round module exposed to the air to allow for moisture to evaporate and round module covers are also difficult to remove and replace to assist with drying. Round modules clumped tight in sausage formation will also limit airflow between modules.
- Isolation for express ginning of high moisture round modules can be difficult, as they can be lost in the multitude of modules produced in a shift. Cartage of several (5–6) round modules can also make isolation of these modules at the gin difficult.

### Contamination

Contamination of cotton with foreign substances lowers the value of the product and often causes problems and increased costs for those processing the cotton at both the gin and the spinning mill. Australian cotton is recognised as one of the least contaminated cotton's in the world and receives a premium. Any contaminants lower the value of the final product and can potentially damage Australia's reputation as a supplier of quality cotton. This standard must be maintained and the responsibility for keeping

Australian cotton clean and contamination free rests with everyone involved in growing the crop, preparing it for harvest, harvesting and module construction, transport to the gin, ginning and shipping to the mill. By far the largest contribution to contamination occurs at harvesting and module building time.

There are two types of contamination:

- **Natural** – Such as the likes of rocks, wood, leaf, bracts, bark, green leaf, burrs and grass. As well as honey dew which are produced by aphid/whitefly which cause a sticky sugary substance which causes problems in ginning and spinning. Many of these natural contaminants can be avoided with careful management and good agricultural practices both prior to and during harvest.
- **Man made contaminants** – Synthetics such as plastic and twine, oil, hydraulic oil, grease, pieces of metal and equipment as well as food wrappers, drink bottles, mobile phones, cleaning rags can also find their way into a grower's module. Mostly these man made contaminants can be eliminated. Trial markers (pink tape etc) are a source of contamination and should be removed prior to harvest.

A site inspection before putting down a module can prove very useful. Rocks and dirty and discarded cotton is a common form of contamination and can be avoided if an inspection is carried out. All workers should be trained to watch out for contaminants. Make them aware of the potential problems and provide them with the facility to clean up and isolate rubbish, for example provide garbage bins in which all waste is thrown and use only white cleaning rags.

**These guidelines have been extracted from the Draft BMP for Harvesting and 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](https://www.mybmp.com.au/auth_user/grower_tools_and_resources.aspx)

- FIBREpak
- An example module information form can be found in the Fibre Quality module in *myBMP*.

<http://www.cottonaustralia.com.au/library/publications/bb-safe-picking-transport.pdf>

Pick N Match – Cotton Australia website if in need of a contractor

To register as a contractor email Cotton Australia on [talktous@cotton.org.au](mailto:talktous@cotton.org.au)