Liberty Link® Cotton and Liberty® 200 Herbicide

Crop Management Plan

Bayer CropScience

Version 2009 (17.02.09)

TABLE OF CONTENTS

Disclaimer

The information and recommendations set out in this manual are based on tests and data believed to be reliable at the time of publication. Results may vary, as the use and application of the products is beyond our control and may be subject to climatic, geographical or biological variables and/or developed resistance. Any product referred to in this manual must be used strictly as directed and in accordance with all instructions appearing on the label for that product and in other applicable reference material. So far as it is lawfully able to do so, Bayer CropScience Pty Ltd accepts no liability or responsibility for loss or damage arising from failure to follow such directions and instructions.

This Crop Management Plan is to be interpreted subject to the licence to use Liberty Link Technology, between Bayer CropScience and the Grower

1. INTRODUCTION

Liberty Link Cotton (i.e. cotton varieties containing Liberty Link technology) has been genetically modified to be tolerant to glufosinate-ammonium, allowing for effective weed control in cotton. Liberty Link Cotton is tolerant to repeated applications of Liberty 200 Herbicide when used in accordance with label recommendations. This innovative technology, developed by Bayer CropScience, offers growers an exciting new herbicide group for the control of weeds in cotton.

Prior to the development of Liberty Link, cotton, like most plants, was susceptible to injury from direct contact with glufosinate-ammonium and therefore the herbicide was not registered for use nor could be used safely within the growing crop. The use of Liberty 200 Herbicide in Liberty Link Cotton in rotation with conventional and Roundup Ready cotton can reduce the selection pressure on weeds from current in-crop herbicides and Roundup Ready® technology.

Use of Liberty 200 Herbicide in conjunction with Liberty Link Cotton will allow more flexible weed management programs reducing reliance on soil preparation, soil-applied residual herbicides, inter-row cultivation and manual labour for weed control. Therefore, Liberty 200 Herbicide and Liberty Link Cotton will be important in contributing to the sustainability of Australian cotton farming systems.

Liberty Link technology will allow over the top (OTT) applications of Liberty 200 Herbicide in irrigated, dryland or ultra narrow row (UNR) cotton systems from crop emergence through to 10 weeks prior to harvest. This wide application window will be most beneficial in removing seedling weeds present in the plant row and furrow, ensuring flexibility in weed control during adverse weather conditions or later germinations of weeds.

The purpose of this Crop Management Plan is to provide information to cotton growers, in conjunction with the product labels and licence agreement between Bayer CropScience and growers, for the successful use of Liberty Link Cotton and Liberty 200 Herbicide.

2. INTEGRATED WEED MANAGEMENT IN COTTON

Weed control in any crop production system can be extremely costly and in some cases, despite the variety of alternatives for weed control, less than 100% effective.

Weeds compete for valuable soil moisture and nutrients, as well as acting as hosts for various insects and diseases. Cotton seedlings are notoriously poor competitors, and therefore weeds can lower crop yield and adversely impact harvesting operations.

Using Liberty 200 Herbicide (Group N Herbicide) on Liberty Link Cotton varieties in rotation with a Roundup Ready Herbicide (Group M Herbicide) on Roundup Ready cotton will reduce the risk of weed resistance to either of these herbicide groups. Both Liberty

Link Cotton and Roundup Ready varieties can also be grown in rotation with conventional cotton.

Figure 1: Tactics which may be employed in an Integrated Weed Management System in cotton

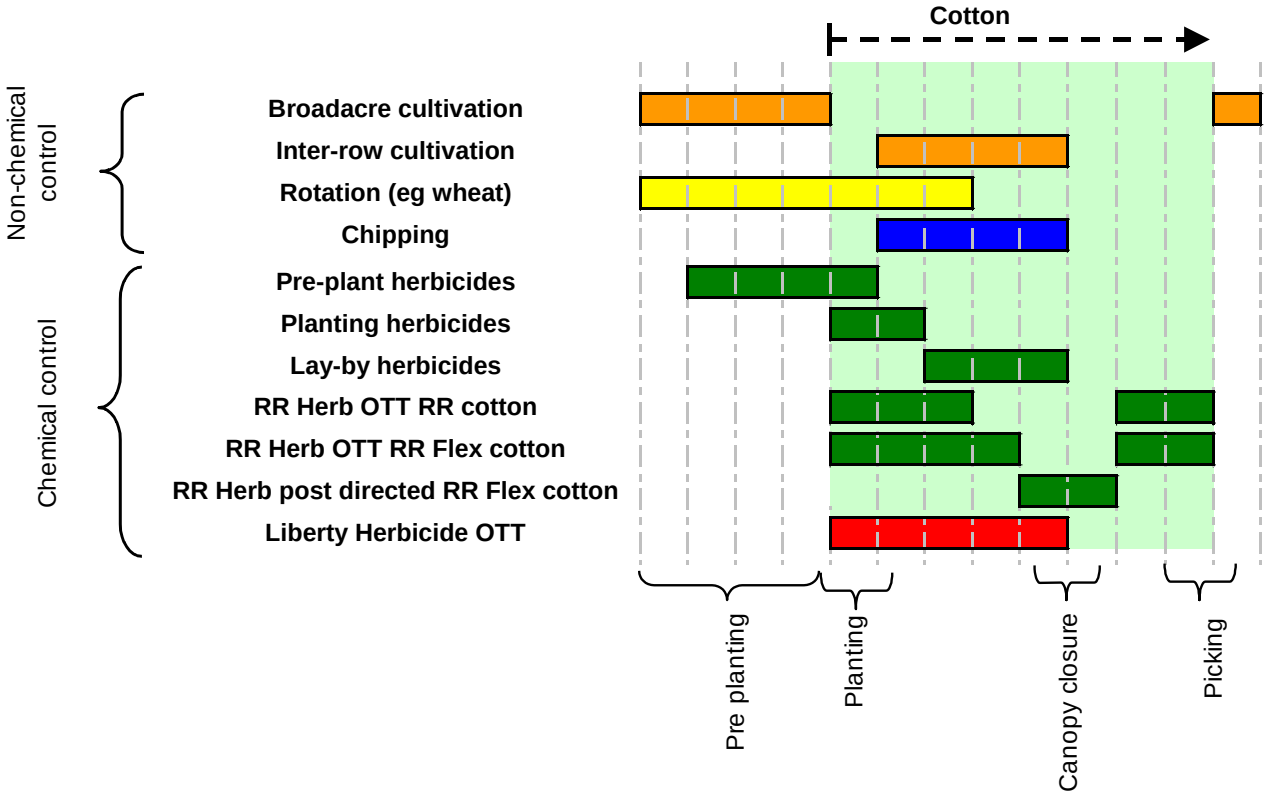

Figure 1 gives a diagrammatic representation of a number of tactics which may be employed by cotton growers in an Integrated Weed Management System.

Further clarification of how Liberty Link Cotton and Liberty 200 Herbicide could fit into a cotton rotation is provided in Tables 1 & 2 below.

2.1. UNDERSTANDING WEEDS AND IMPLICATIONS FOR THEIR MANAGEMENT

Weeds are most competitive in early crop growth stages. Therefore, it is important to accurately identify individual weeds and have a thorough understanding of appropriate and effective control strategies.

Weed populations are often a reflection of field history and the effectiveness of previous herbicide programs and/or mechanical control in fallow or in crop. Variations in particular weed dominance from year to year and season to season can also impact on weed control programs.

Correct identification of individual weeds can be difficult, often complicated by the fact that common names of the same weed species can vary between geographical regions. A useful tool for weed identification is the weed seed size and shape. The nature of the weed seed can also impact on the method and ultimately the effectiveness of its control.

The weed control option often varies according to the population of weeds by field or management unit, soil types between farming systems and the degree of infestation or "patchiness" of particular weeds.

Understanding weeds, their life cycles, competitiveness and susceptibility to various herbicides is vital in the development of a suitable Integrated Weed Management System (IWMS), providing growers with a more efficient and effective decision making process for weed control. The Australian Cotton CRC guide 'WEEDpak' is a valuable source of detailed information on the weeds found in Australian cotton crops (available at www.cotton.crc.org.au).

2.2. LIFE CYCLES OF WEEDS

Knowledge of weed life cycles is important in the timing of herbicide applications.

In cotton cropping systems, the majority of weeds species have an annual life cycle. These weeds flower, produce seeds and die within a season. Summer annuals germinate in the spring, flower and then set seed in the summer to autumn, then die when winter arrives. They produce large numbers of seeds, which may require specific degrees of moisture, temperature, and light to germinate the following season.

Dormancy and survival of seed is directly influenced by genetic factors (hard seed) and environmental factors (soil moisture, tilth, temperature, microbial activity and fauna).

Perennial weeds live for many years. They can reproduce by seed, but many also produce new shoots from shallow rhizomes, stolons, tubers or bulbs. The vigorous perennating nature of these plants makes them extremely competitive in annual crops (such as wheat), or perennial crops grown as annuals (such as cotton) where dispersal is aided by cultivation. Polymeria (*Polymeria longifolia*), nutgrass (*Cyperus* spp.) and couch grass (*Cynodon* spp.) are examples of perennial weeds.

Classification of weeds and their correct identification provides the basis for the selection of an appropriate control strategy. Good record keeping complements this, as weed spectrums change over time. Previous herbicide programs and in-crop weed management histories are key considerations of good weed management systems.

2.3. INTEGRATED WEED MANAGEMENT STRATEGIES

Weed control in both irrigated and dryland cotton production involves the use of a range of management tools. These include out of season control options, land preparation, chipping, inter-row cultivation, both pre plant and in crop selective and non selective herbicides.

The use of a range of such options, rather than reliance on any one single weed control option, is the basis behind an Integrated Weed Management System (IWMS). Such an

integrated approach to weed control has, to date, allowed the Australian cotton industry to avoid any documented development of herbicide resistance.

One of the aims of an IWM strategy is to prevent the evolution of herbicide resistant weeds by preventing viable seed set in weeds. This may be achieved by following these basic guidelines:

1. Use as many different weed control options (chemical and non-chemical) as necessary in both crop and fallow phases.

2. Enter a cropping phase with low weed numbers.

3. Ensure that each herbicide application is effective. Use full label rates.

4. Rotate herbicides from different groups.

5. Minimise and limit the number of weed "escapes".

6. Prevent viable seed set of any survivors by practices including chipping, inter-row cultivation and the post harvest listing/re hilling.

The adoption of Liberty Link Cotton will offer a sustainable weed control alternative to the cotton industry. The extent to which chemical or mechanical components are employed for weed control will be determined by the weed spectrum and density as well as access to the field (eg: following irrigation).

Consult 'WEEDpak' for more detailed information on Integrated Weed Management in cotton.

Resistant Weeds Warning **GROUP N HERBICIDE**

Liberty 200 Herbicide is a member of the glycine group of herbicides.

Liberty 200 Herbicide is an inhibitor of glutamine synthetase. For weed resistance management Liberty 200 Herbicide is a Group N herbicide. Some naturally occurring weed biotypes resistant to Liberty 200 Herbicide and other Group N herbicides may exist through normal genetic variability in any weed population. The resistant individuals can eventually dominate the weed population if these herbicides are used repeatedly. These resistant weeds will not be controlled by Liberty 200 Herbicide or other Group N herbicides.

Since occurrence of resistant weeds are difficult to detect prior to use, Bayer CropScience Pty Ltd accepts no liability for any losses that may result from the failure of Liberty 200 Herbicide to control resistant weeds.

2.4. WEED MANAGEMENT OPTIONS IN A LIBERTY LINK COTTON SYSTEM

Table 1: Example of weed management programs in Liberty Link Cotton crops

Situation*	Strategy
Heavy broadleaf Infestation, especially peach vine, bladder ketmia and dwarf amaranth	– Pre-plant or at plant incorporated selective herbicide – Liberty 200 Herbicide over-the-top of the established Liberty Link Cotton crop (1-3 applications) – Inter-row cultivation – Lay-by or selective herbicides if required

* example only; refer to Liberty 200 Herbicide label for details of weed spectrum

The Liberty Link system offers growers flexibility in weed control options. However, for growers who have fields with heavy weed burdens, or those that may not have the spraying equipment to treat their entire Liberty Link plantings in a timely manner, Bayer CropScience recommends the use of pre plant or at plant residual herbicides as a supplementary means of control.

2.5 VOLUNTEER COTTON

Volunteer cotton can be a significant component of a weed spectrum in established cotton growing areas. Liberty 200 Herbicide provides effective control of all volunteer cotton with the exception of Liberty Link seedling volunteer cotton.

In Roundup Ready and Roundup Ready Flex cotton Liberty Link Cotton seedling volunteers will be effectively controlled by label rates of Roundup Ready. Refer to product label.

Liberty Link cotton seedling volunteers will require alternative control methods when they are present in a crop of the same variety. This may include similar measures to those used for removing conventional cotton seedling volunteers from conventional cotton crops such as;

- the use of appropriate herbicides as shielded/directed sprays
- watering -up then controlling emerging volunteers with appropriate herbicides
- the application of post-plant pre-emergence herbicide applications

Volunteer and ratoon Liberty Link cotton needs to be controlled in non-cropping areas as it harbours pests and diseases. Control may be achieved by cultivation or the use of herbicides as appropriate.

Table 2: Registered herbicides for use in cotton

Pre-plant	Post plant pre-emergence	In crop – Lay-by
diuron fluometuron fluometuron/prometryn glyphosate metolachlor norflurazon paraquat/diquat pendimethalin prometryn trifluralin	diuron fluometuron fluometuron/prometryn glyphosate metolachlor pendimethalin prometryn Liberty 200 Herbicide (in Liberty Link cotton)	butroxydim clethodim diuron fluazifop-p butyl ester fluometuron fluometuron/prometryn halosulfuron-methyl haloxyfop-R methyl ester prometryn propaquizafop pyrithiobac norflurazon sethoxydim trifloxysulfuron Roundup Ready Herbicide (in Roundup Ready and Roundup Ready Flex cotton) Liberty 200 Herbicide (in Liberty Link cotton)

Refer to respective labels for directions

3. ACCREDITATION AND COMPLIANCE

3.1 ACCREDITATION

Persons engaged in selling and giving agronomic advice on Liberty Link Cotton or who are responsible for growing the crop must complete an appropriate Liberty Link Cotton & Liberty 200 Herbicide Accreditation Programme. that will be updated on a regular basis.

Accreditation will require attendance at a training course conducted under the direction of Bayer CropScience and passing a competency assessment.

It will be necessary to complete an optional additional module to be accredited to conduct a Liberty Link Cotton Weed Audit.

3.2 PURCHASING THE SEED

Liberty Link Cotton seed will only be available through accredited Distributors (TSPs). Liberty Link Cotton Distributors are trained to ensure they manage Liberty Link Cotton seed correctly, and that they record lot numbers of the seed on grower invoices, to ensure traceability through the supply chain.

To buy the seed growers will need to show that they are accredited and have signed the farmer licence agreement with Bayer CropScience.

3.3 THE CROP MANAGEMENT PLAN

Prior to purchasing seed for planting the grower will be required to sign a Licence agreement that includes a commitment to comply with this Crop Management Plan (CMP). When growing Liberty Link Cotton, growers are responsible for following the CMP.

3.4 THE LIBERTY 200 HERBICIDE LABEL

When Liberty 200 Herbicide is used in Liberty Link cotton the label attached to the container must be read and all instructions followed. In addition to directions on applying the product which will ensure its optimal performance, the label contains important information relating to operator safety, drift management, environmental protection plus certain important restrictions on use.

3.5 GROWERS' ROLE

Growers of Liberty Link Cotton are free to choose whether or not to use Liberty 200 Herbicide dependent upon their weed management requirements, but this Crop Management Plan only applies to the use of Liberty 200 Herbicide on Liberty Link Cotton.

Growers must comply with all requirements of the licence agreement and Crop Management Plan. Failure to adhere to the CMP and licence conditions will result in consequences as described in the licence agreement.

Growers who can demonstrate full compliance to the following four points will be eligible to grow Liberty Link Cotton the following season:

1. Adherence to all requirements of the CMP

2. Adherence to all requirements of the Licence agreement.

3. Adherence to all product label instructions when using Liberty 200 Herbicide in Liberty Link Cotton

4. Demonstrated compliance to conditions during audits.

As stipulated in the licence agreement growers should produce a map showing fields planted to Liberty Link cotton plus fields planted with conventional and other transgenic cotton. It is highly recommended that signs be placed at the entry points to each field indicating the presence of Liberty Link cotton in that field.

Growers are required to report any adverse event such as suspected weed resistance to Bayer CropScience as soon as it is identified.

3.6 AUDITING

As specified in the Licence agreement, audits, including a weed audit are to be conducted during the growing season.

Weed audit
The Grower who holds the Liberty Link license is responsible for ensuring a weed audit is conducted in each field of Liberty Link Cotton that has been treated with Liberty 200 Herbicide.

The audit is to be conducted 14 - 18 days after an application of Liberty 200 Herbicide, and should be planned to ensure that it occurs prior to canopy closure.

Only a person who is suitably accredited to conduct a Liberty Link Cotton Weed Audit is able to perform the audit. This may be the grower or their nominated representative (employee, private consultant or TSP) provided they are accredited.

The audit process requires the following actions;

- *Audit method A:* For each field, areas representative of the weed burden prior to spraying should be selected for audit, based on the pre-spray inspection, which determined the need to use Liberty 200 Herbicide. At least three of the four quarters of the field should be entered for this inspection. 2 x 50 metres linear row, each at least 20 rows apart, should be audited in each quarter.

  OR

  Audit method B: If the audit is being conducted by an individual who was not involved in the pre-spray inspection the following criteria can be used as a guide to selecting areas for audit.

Field size	Metres of Row to be Audited
< 50 ha	4 x 100 metres linear row
51-100 ha	6 x 100 metres linear row
101-200 ha	8 x 100 metres linear row
> 200 ha	8 x 200 metres linear row

The minimum distance between each 100 m or 200 m count must be 100 rows.

- Assess the weeds and volunteers surviving the Liberty 200 Herbicide application, determining a rating of the infestation severity for each surviving weed/volunteer.

- Complete the *Liberty Link Cotton Weed Management Audit* form as required indicating;
  - The rating of the infestation severity for each surviving weed/volunteer
  - General comments on weed control
  - Remedial action taken to control surviving weeds prior to seed set

- Fax the completed form to Bayer CropScience, as soon as possible after it is finalised, and definitely no later than 31st December of the year the crop was planted.

- Any adverse events, such as suspected weed resistance to Liberty 200 Herbicide, should be reported to Bayer CropScience immediately they are identified.

- If weed resistance is suspected, and there is an opportunity to do so, collect mature seeds from the plants in question.

Bayer will collate all data received from the weed audits and report its findings to the TIMS Weeds Sub-Committee.

4. SOURCES OF INFORMATION

Further information and advice can be obtained by referring to the following sources of information:

- Your local Bayer CropScience representative
- Bayer CropScience website (www.crop.bayer.com.au)
- Bayer CropScience technical enquiries number 1800 804 479
- Bayer CropScience, Level 1, 8 Redfern Rd., Hawthorn East, Vic 3123

APPENDIX 1: LIBERTY 200 HERBICIDE DIRECTIONS FOR USE (Please refer to full label for further instructions)

DIRECTIONS FOR USE
Restraints
DO NOT apply to cotton varieties other than Liberty Link cotton
DO NOT apply by aircraft.
DO NOT apply by mister.
DO NOT apply when rain is expected within 6 hours or irrigate until 6 hours after application.
DO NOT apply onto weeds when dew, fog or mist is present.
DO NOT apply to weeds under stress due to, for example, very dry, very wet, frosty, windblasted, insect damaged, nutrient deficient or diseased conditions or as a result of a previous herbicide treatment.

CROP	WEED	WEED STAGE	RATE	CRITICAL COMMENTS
Liberty Link® cotton Note: Liberty Link cotton includes Liberty Link and Liberty Link/Bollgard® II cotton varieties	**Control of:** Annual polymeria Bellvine Bladder ketmia Caltrop Dwarf amaranth Field bindweed (European bindweed) Flax-leaf fleabane Paddy melon Peach vine Red pigweed Rhyncho (Rhyncosia) Sesbania pea Sowthistle (Milk thistle) Volunteer cotton (other than Liberty Link cotton) Yellow vine **Suppression of:** Chinese lantern (Wild gooseberry) Noogoora burr complex	2-6 leaf	3.75 L/ ha in a minimum of 100 L water	Apply to actively growing weeds. Good coverage is essential. Refer to **Climatic Conditions** section of the label. Do not apply more than 3 applications per season. Liberty 200 Herbicide may cause minor and transient spotting on leaves which are directly contacted by spray applications. This has not been shown to have any impact on crop growth and development.

NOT TO BE USED FOR ANY PURPOSE, OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

APPLICATION OF LIBERTY 200 HERBICIDE TO COTTON VARIETIES OTHER THAN LIBERTY LINK COTTON WILL RESULT IN SEVERE CROP INJURY OR DEATH OF THE CROP.

WITHHOLDING PERIODS
Harvest
DO NOT APPLY LATER THAN 10 WEEKS BEFORE HARVEST.
Grazing
DO NOT GRAZE OR CUT TREATED VEGETATION FOR STOCK FEED.
DO NOT FEED COTTON TRASH TO LIVESTOCK.

APPENDIX 2: LIBERTY LINK COTTON SEED LABEL

LIBERTY LINK® COTTON SEED

This bag contains seeds of genetically modified cotton, tolerant to Liberty® Herbicide, approved under OGTR Licence No. **DIR 062/2005**

- This seed may only be used and grown by growers who have a signed Licence (Technology User Agreement) to buy and use Liberty Link Cotton and current accreditation from Bayer CropScience Pty Ltd. Users must follow the terms and conditions of the Licence to use Liberty Link Technology.
- Liberty Link Cotton must be grown in accordance with instructions contained in the Liberty Link Cotton and Liberty Herbicide Crop Management Plan.
- The Liberty Herbicide tolerant gene in this seed is protected by one or more Australian Patents and Australian intellectual property laws and may only be used by growers who have a signed Licence with Bayer CropScience Pty Ltd.
- The Grower must notify Bayer CropScience Pty Ltd immediately of any breaches of the Licence including but not limited to any breaches of the Liberty Link Cotton and Liberty Herbicide Crop Management Plan.
- Liberty Link Cotton is tolerant to Liberty Herbicide and is not tolerant to glyphosate or other non-selective herbicides.
- **Exclusion of Liability** - This product must be used strictly as directed, and in accordance with all instructions appearing on the label and in other reference material. So far as it is lawfully able to do so, Bayer CropScience Pty Ltd accepts no liability or responsibility for loss or damage arising from failure to follow such directions and instructions.

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THESE SEEDS ARE PROTECTED UNDER ONE OR MORE AUSTRALIAN PATENTS