Cotton Research and Development Corporation
Funded Project

United States of America Cotton Study Tour

Final Report

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UNITED STATES EXTENSION COTTON TOUR

1. Background

In America, the total production area of UNR cotton is small. It consist of less than 1% of the total area planted to cotton in the USA (100,000 acres) for the 1999 season. Commercial production of this system is focused in the states of Arizona, Alabama, Texas, Arkansas, Mississippi, North Carolina, South Carolina, Georgia, California and Louisiana. These states also have large areas planted to conventional cotton.

UNR cotton is grown in both the traditional Cotton Belt and marginal fringes. The migration of cotton into these marginal areas is a direct result of non-traditional cotton growers expanding their farming systems. These non- traditional cotton growers were forced to investigate alternative crops due to a constant decline in their farms' income from non-cotton (traditional) sources. A negative impact of this expansion has been the development of cotton in areas where soil and environmental conditions limited yield potential. Resulting in a need for producers to grow cotton using existing farm equipment and above all maintain a very low input costs, ensuring their viability. This has lead to the development of UNR cotton that is planted using grain drill machinery.

UNR cotton in America is classified as cotton grown under row spacings of 20 inches or less. These crops exist with the bulk of the cotton planted between the range of 7 to 15 inches. The availability of planters within the farming system is a significant factor in determining these plant spacings.

Australia and the United States researched the UNR production systems during the 1960-70's with mixed results. The development of growth regulators and their strategic use has facilitated in UNR being re-visited as a production system. Without this tool, crops grew into large plants that caused both trash and harvesting problems. Today in Australia there still appears to be areas that require research before the cotton industry could fully endorse UNR cotton as a main stream production alternative. The two major areas that require improvements, are the harvesting of the crop and subsequent processing of the seed cotton. The actual planting of the crop and associated agronomics of the crop still requires some research.

In summary, despite the major set backs of the 1960-70's, there continues to be a loyal group of growers in the USA that are persevering with the system, and adapting newly developed technologies. As time has evolved these core growers are jointed by new growers attracted to the system, simply because of the possibility of "earliness", improved yield potential and economical viability. Especially in an environment where production costs associated with traditional cotton production are constantly increasing, with returns remaining stagnant. It is for these reasons, also that Australian producers are interested.

2. Objectives of the Study Tour

For the duration of the study tour, I travelled with three other Australian Cotton Extension Officers. Each officer was investigating their own topic of interest with topics ranging from What are the components of an American farming system? To programs that promoted best management practice techniques on farms.

My study tour focused on the current performance and available technology growers access to in their quest to produce UNR cotton. On the tour I was able to consult with researchers and conduct meetings with growers and consultants to discuss their experience of UNR cotton.

In conjunction to collating this valuable information I was able to establish communication links with industry personal within America who are associated with UNR cotton. These links will facilitate in information transfer between Australia and the United States on various research topics.

3. Travel Itinerary

July 1999

Day	Date	Location	Activities and Highlights
Mon	5	San Francisco CA	Arrive in the USA, travel to Santa Cruz on route to the San Jouqinn Valley
Tue	6	Merced CA	Dr Bill Weir, Farm Adviser, Uni of California Daniel Burns, Cotton Grower, 'San Jaun Ranching' Dos Palos
Wed	7	Visalia CA	Steve Wright, Farm Adviser, Uni of California
Thu	8	Corcoran CA	Bruce Roberts, Farm Adviser, Uni of California JG Boswell Company, Jim Razor, Nathan Heeringa, Tim Sherrill,
Fri	9	Shafter CA	Bob Hutmacher, Extension Officer Cotton, Uni of California Dr Glen Fitzgerald, Remote Sensing & GIS Researcher USDA
Sat	10	Los Angeles CA	Domestics Flight
Sun	11	LA to Memphis TE	Travel to Memphis, Tennessee
Mon	12	Jackson TE Milan TE	Dr Owen Gwathmey, Crop Physiologist, Uni of Tennessee Dr Blake Brown, Superintendent, Milan Experiment Station Dr Melvin Newman, Extension Plant Pathologist, , Uni of Tennessee
Tue	13	Benoit MI Stoneville MI	Charles Coglan, Cotton Grower Gordon Andrews, Extension Entomologist, Mississippi State Uni. James Robbins, Entomologist, Mississippi State Uni. Dr Will McCarty, Cotton Specialist, Mississippi State Uni. Dr Jane Dever, Agrevo Dr Alan Blaine, Soybean Extension Specialist, Mississippi State Uni. Dr Jim Thomas, Irrigation Engineer, Mississippi State Uni.
Wed	14	Stoneville MI	Fibremax Variety Experimental Plots: Brad Lewis, Jeff Gwynn , Agrevo Attend Delta Farm Fest, Agricultural Field Day Trey Cook, Executive Director, Delta Farm

Thu	15	Scott MI	Deltapine International Headquarters ❑ Dr Kater Hake, Vice President, Agronomic Services ❑ Dr Kevin Howard, Agricultural Engineer ❑ Jay Mahaffey, Technical Service Entomologist ❑ Jim Presley, Regional Agronomic Service Manager ❑ Dr Harry Collins, Head of D&PL Transgenic Program ❑ Tom Ledher, President, D&PL International
Fri	16	Travel	Travel form Cleveland MS to Palastine TX
Sat	17	Travel	Travel from Palastine TX to College Station TX
Sun	18	Hewitt TX Riesel TX	Mark Nemec, Cotton Consultant. Chris Dahl, 'Robinson Field' Cotton Grower.
Mon	19	College Station TX	Cotton Incorporated Breeders Tour Dr James Supak, Extension Program Leader, Texas A&M Dr Paul Baumann, Extension Weed Specialist, Texas A&M Robert Lemon, Cotton Agronomist, Texas A&M
Tue	20	Robstown TX	Harvey Buering, County Extension Agent, Texas A&M
Wed	21	Memphis TE	Travel from Corpus Christi TX to Memphis TE Domestic Flight
Thu	22	Milan TE	Attend Milan No Till Field Day; Numerous researchers and extension personal.
Fri	23	Travel	Travel from Memphis TE to Los Angeles CA. Domestic Flight
Sat	24	Travel	Travel from Los Angeles to Sydney
Sun	25	In flight	
Mon	26	Travel	Arrive Sydney 6:00 AM, Arrive Tamworth 10.30 AM

3.1 Field Days and Contacts Related Directly to UNR Cotton

Field Days: 1. Milan No Till Field Day , Milan, Tennessee
2. Delta Farm Fest, Agricultural Field Day, Benoit, Mississippi

Contacts:
1. JG Boswell Company: Jim Razor, Tim Sherrill, (Managers) & Nathan Heeringa (Agronomist), Corocran, California
2. Daniel Burns, Cotton Grower/ Manager, 'San Jaun Ranching' Dos Palos, California
3. Dr Bill Weir - Researcher, University of California, Merced ,California
4. Dr Owen Gwathmey - Researcher, University of Tennessee, Jackson Tennessee
5. Dr Blake Brown - Superintendent, Milan Research Station, Tennessee
6. Charles Colghan - Grower, Benoit, Mississippi
7. Dr Mike Buschermohle - Researcher, University of Tennessee, Jackson, Tennessee
8. Dr Bob Hayes - Researcher, University of Tennessee, Jackson, Tennessee
9. Dr Robert Lemon - Farm Adviser, College Station, Texas

4. Planting Issues

Many producers in the USA are assessing wether UNR cotton is a viable option. Thus growers are assessing the system by planting cotton with their existing broadacers planters. This is their preferred option rather than purchasing a more expensive crop specific planter. For this reason, UNR cotton is commonly sown on spacings of 7.5, 10 or 15 inches.

For example, non traditional growers in the State of Mississippi have a desired row spacing of 7.5 inches. This spacing allows growers to use their pre existing combine (broadcaster) planter for both cotton and rice. The most common planter used to achieve this spacing is the range of John Deere grain drills. While in Texas, producers use a mixture of 'combine' metering systems and precision planters. The grain drills are used to achieve the 7.5 inch spacings as above. While the precision planters are used to achieve the 10 to 15 inch spacings.

Various growers across the cotton belts are now purchasing the Monosem planters to achieve both the desired spacing but more importantly improved accuracy in seed placement, as the grain drills are not effective in this area. Overall, the ultimate decision as to which row spacing is used is highly dependent on the existing planters on the farm. The option of purchasing a more expensive precision planter is a long-term plan for most growers entering the UNR production system.

4.1 Grain Drills

Planting cotton on very narrow rows is certainly achievable using a grain drill. However, it is at the expense of accuracy for both seed placement and depth control along the plant line. These were two disadvantages that were constantly raised by growers in all states I visited. Producers trialing UNR cotton as an option for their farm are willing to sacrifice the ability to be precise in seed placement for the ability to use pre-existing equipment. Many new producers are attempting to grow cotton in production areas that have low yield potential. This low yield potential could be due to a range of reasons from soil type to environmental constraints. It is for this reason that growers require very low operational expenditure and the planter falls into this category. As growers learn more about the UNR system, they are starting to understand the importance of having a uniformly established crop in their quest for earliness and yield advantage. Especially where grain drills are used and result in variation of plant stand uniformity is creating some management problems such as inefficient weed control.

Growers who are not of this belief or are accepting of this shortfall, are now using a new series of grain drills called the Great Plains 2000's. These planters appear to have slightly improved accuracy, but overall the machine still has a combine metering system. Grain drills in general can achieve populations around 300,000 plants + / ha, which is within the target plant population. However, when assessing these plant populations on a per square metre basis, the uniformity result is highly variable. This variation is even worse if the grower plants the crop at a level below 200,000 plants /ha.

If growers were wishing to plant cotton into raised seed beds, then grain drills are NOT the option. Simply because, like most of these machines, the depth control is governed by the downward pressure of the press wheel. A planter unit on the edge of the bed (outside rows), has a tendency to either slide off the bed's shoulder or place the seed too shallow into dry soil. Resulting in an uneven planting depth and subsequent establishment problems across the bed.

4.2 Precision Planters

Precision planters are providing an accurate seed distribution and have been used commonly where growers are planting into raised seed beds. The narrowest row spaced tractor mounted planter available to the growers in the USA is the Monosem brand (see figure 1 and 2). The restriction in choice has not damped the enthusiasm, growers have for this machine. All the producers I spoke to, who currently use this style of planter, highly recommend the unit. The biggest advantage of the planter is the ability to repeatedly sow a uniform plant stand both along the row and between rows at a reasonably narrow spacing. This is the current experience in Australia as well.

Figure 1: 8 row (24 unit) planter

Figure 2: Closeup of the unit positions

In my opinion there are only three negative features with this particular planter. Firstly, the minimum row spacing achievable on a single toolbar is 10 inches. Secondly, some questions have been raised over the maintenance cost of the planter. Especially in the heavy stubbled fields such as the rolling country of Tennessee and the high plains of Texas. Thirdly, and perhaps the largest negative, is the initial purchasing price. Growers should rationalise the price and consider that the planter will cost more simply because it is a precision planter with 3 times the amount of sowing tines as traditional precision planters. This cost factor is certainly an issue when UNR growers are focusing on low input production systems. A machine that is 8 metre wide and consists of 24 row units will costs approximately $100,000 - 110,000 Australian dollars.

There is an alternative machine that can sow a minimum row spacing of 15 inches on a single toolbar setup. This planter is produced by John Deere, and is called the 1780 Maximerge Plus. I was unable to see any fields that were sown with this machine, however grower reports indicated this machine to be cheaper to purchase and comparable to the Monosem in performance. Overall, this machine offers the precision that is required in UNR cotton but not the row spacings.

4.3 Planter Summary

Maximising "earliness" in a UNR crop, requires a good start to the season. A good start is strongly linked to the need to have a very uniform plant stand established. An evenly spaced plant stand avoids gappiness in the crop. It is essential that large planting gaps are avoided, otherwise weeds will grow and occupy this field space, thus reducing the amount of nutrients and moisture available to the cotton. Extra drymatter in the form of weeds can also cause harvesting problems. The weeds can add trash in the lint and cause blockages in the fingers of the front. Overall, American extension and research information indicates that a precision cotton planter is an essential component of UNR cotton production. From my limited observations of various fields, the Monosem planter gave the most uniform and repeatable establishment. Despite this information, there are still growers persisting with combine machines. The fields planted using a grain drill resulted in gaps and a weed problem, especially in the south and southeastern regions of the USA, where vine weed species were present.

5. Agronomic Issues

5.1 Earliness

Research into quantifying the earliness advantage obtained from an UNR production system is currently being assessed by Dr Owen Gwathmey (Tennessee). His research compared UNR cotton planted on 7.5 inches row spacings to conventional cotton sown 40 inches apart. Both systems were grown under dryland conditions, however the average annual rainfall at the experimental site is approximately 40-50 inches. With well timed summer rainfall accounting for 10-15 inches. So for the purpose of the comparison, the system is not limited by moisture and the results could be related to an irrigated system.

Dr Gwathmey's experimental results in Tennessee indicate that flowering of UNR cotton occurs 5 days earlier than the conventional cotton. With "cutout" being reached one week after the commencement of flowering. In comparison, the conventional cotton reached "cutout", 2 weeks after flowering commenced. Overall, the results from the experiment indicate that UNR had a maturity advantage of 17 days.

A 2 week plus maturity advantage in Tennessee then allows cotton to be a viable No-till rotational crop with wheat. Cotton can also provide a disease/weeds break to wheat while still generating an attractive income. This earliness advantage allows UNR cotton to be matured and harvested in a time frame which allows a subsequent wheat crop to be planted within the optimal planting window. On average, the harvesting of UNR cotton occurs in October, which is historically the month with the lowest probability of rainfall. Following are examples of how UNR cotton can be incorporated in a rotation cycle in Tennessee.

5.2 Rotation Options

Long Rotation Option

1. UNR Cotton
2. Winter wheat grown to harvest
3. Double crop the wheat into soybeans
4. Fallow then Corn
5. Drill UNR Cotton into corn stubble

Short Rotation Options

1. UNR cotton
2. Winter wheat or cereal as cover crop only-(sprayed out)
3. Corn
4. Fallow through to UNR cotton

5.3 Sunlight interception Associated with UNR Cotton

Numerous researchers and extension personal in the United States including Dr Robert Lemon and Dr Tom Gerik have compared the ability of UNR and conventional canopy to intercept sunlight as measure of leaf area efficiency. These researchers found the UNR canopy to be more efficient, simply because of the extra leaf area per square metre of soil. Growers planting between-120,000 - 140,000 plants/acre, (247,000-345,000 plants/ha), achieved this improved leaf area efficiency of UNR. Growers planting this population of plants were targeting a yield potential between 1 to 2.5 bales/ac (2.47-6.17 bales/ha).

5.4 Nutrition

Applied nitrogen in UNR cotton was generally lower than the amount applied to grow a conventional cotton crop. The extension message emanating from the researchers on this topic was to be conservative with application volumes, and be guided by the yield potential of your area. The aim is to avoid excessive growth throughout the season as it counteracts the strategy that is practiced with growth regulators. Therefore normal nitrogen rates range from 80-100 kg N /ha. The bulk of the total nitrogen is applied as anhydrous gas well prior to sowing of the crop. This is the case for UNR crops sown into irrigated beds. If required, additional nitrogen is then applied as Nitram either broadcasted or aerially just prior to the first irrigation event. This method of nitrogen application is also utilised by producers growing UNR under rain fed conditions. The normal practice is to apply the initial urea at sowing and follow with nitram as a sidedressings if required.

5.5 Growth Regulator Management

Growth regulators can play an important role in the management of UNR cotton. To the point, that the use of these products can determine the success or failure of a crop. Grower experience has established multiply rate doses to be the most effective form of application. Using growth regulators by the multiply rate method is based on the concept of applying a known level of active ingredient to the plant formulated on the estimated drymatter level of the plant. This concept is to theoretically apply the "brakes" to the plant's growth rate at different stages and then finish with a "cutout" application. This differs to the conventional application which applies Pix® solely on a ratio between height to node and is usually a one off application near first flower. The multiply rate dose regime has a common "recipe" which is followed by American grower (listed below). However this "recipe" needs to be strictly balanced with the fruit retention on individual plants, environmental conditions and the fields' uniformity.

Guidelines for Growth Regulator Usage

4 - 8 ounces/ac	at	Pin Square (node 7-8)
6 - 8 ounces/ac	at	Nail Size Squares (node 9-12)
12 ounces/ac	at	once bolls are set "cutout" (node 15-18)

A common theme strongly advocated by all growers and researchers was to apply an early season Pix® application at pin square. As to the actual volume applied at this early stage of growth to be determined by the crop's growth rate. When I posed the question which was more critical; the timing of the application or the actual rate applied, the answer was that timing was the more important factor. The reasoning for this answer is that timely application allows smaller volumes of Pix® to be applied. Thus reducing input costs, which make the system more cost effective.

5.6 Weeds and control options

Both broadleaf and vine weeds can pose a major issue when picking of UNR cotton. In Mississippi, UNR growers have major problems with a weed called Red Vine (Brunnichia ovata) and Morning glory (Ipomoea spp). These weeds choke out the crop and cause blockages in the harvesting fronts during picking. Especially in fields, which are not uniformly spaced and volunteer weeds have been allowed to fill these vacant spaces. However, not all American production areas have to deal with these weeds. In California, the issue of vine weeds is less of a concern. This is because the environmental conditions are less favourable for vine growth given the lower rainfall and humidity.

Figure 3: Left side is no grass herbicide and the right is Roundup Ready UNR cotton

Control Options for Weeds

The development of transgenic cottons such as the Roundup Ready® and BXN tolerant cotton, has certainly been a great advancement for UNR production, figure 3. Growers have been able to identify fields with specific weed problems, and then target those weeds by planting the appropriate transgenic cotton. Growers then apply the herbicide according to the label to control the target weed. However, no technology is without limitations. For example, Roundup Ready® cotton can only have Roundup applied as an "over the top" herbicide up to the 4th true leaf stage. Succeeding this stage of growth, the herbicide must be applied as a directed application to the plant's base. This type of directed spray within a UNR crop is not physically possible, resulting in the product having a limited window of use.

In contrast, BXN tolerant cotton varieties do allow Buctil® (BXN) to be applied "over the top" <u>ALL</u> season. The limitation with this product is the cost of the herbicide Buctril®. The cost of using this product repeatedly through the season is high and this will limit the overall adoption of the technology. Buctril® is also a product that requires maximum contact on the target weed. UNR crops in general possess a dense leaf canopy, which could result in a reduction in the efficacy of Butril® applications. Simply due to reduced surface contact on the target weed and thus a coverage issue develops.

In considering both products limitations, growers are preferring to utilise the Roundup Ready® technology, as they feel there is more return for their dollar invested with this technology. Use of the transgenic varieties should not be used in isolation in fields which are known to have a weed problem. This means an integrated approach to weed management should always be practiced. This means the employment of practices such as using a good pre-emergent herbicide program supported by isolated chipping and herbicide rotation. The key is not to rely solely depend on transgenic technology for weed control. Using these management strategies reduces the possibility of resistance developing to the technology.

6. Insect Control

Dr Nancy Van Toll from the state of Tennessee, has for the last 2 seasons assessed the UNR cotton plant's ability to compensate for early season plant damage caused by thrips and aphids.

The experiments included replicated plots of UNR cotton with the treatments of Temik® (0.5, 1, 1.5 and 2 lbs ai/acre), Gaucho®, Orthene® (seed treatments) and foliar applications of Bidrin®. All treatments were compared to an untreated control. Dr Van Toll findings indicated there are no significant yield benefits to the grower if they use these products for thrip or aphid control. The only impact of the treatments was a slight maturity delay of a few days in the untreated plots. This delay did not transpose into a yield penalty.

This was interesting research, given that UNR plants are expected to have a reduced ability to compensate for damage. This is because the plants are producing a reduced number of fruiting sites compared to conventional cotton. However this early season damage was occurring pre squaring allowing the maximum time period for compensation to occur.

The two main late season pests found in the southern Cotton Belt are the Boll Weevil and Heliothis (Helicovpera virsence and Helicovpera zea). One pest, which is not found in these areas, is the spider mite. However in California, these are spider mites and also lygus bugs , but no heliothis. Despite the different pest spectrums in these production areas, no UNR cotton grower made any reference to the UNR cotton being a harder crop to control insects in. The only comments made regarding insects, was that with the improved earliness in UNR there is reduced exposure late insect attack. Based on this information, some growers are claiming a 25% reduction in insecticide costs simply due to the shorter exposure period.

7. Yields

Yield advantages have been recorded in Blacklands (Texas) where 7.5 and 15 inch spaced cotton has been compared to the regions traditional row spacing of 30 inches. Dr Tom Gerik and Dr Robert Lemon have done this work. The Blackland crops are 100% dryland so the yield potential is highly dependent on the water availability and season's length. In 1996 an average yield increase of 37 % was recorded for the 7.5 and 15 inch cotton in comparison to the 30 inch cotton. While in 1997, results indicated a 21% average yield increase for UNR row spacings.

8. Harvesting

The harvest preparation for UNR cotton in America is the same as that used in Australia. The crop is firstly defoliated as per conventional cotton, then it is desiccated. The desiccation is to make the plant brittle to assist the stripper fingers during the process of picking. Once the crop has been adequately prepared, a modified finger-stripping front is attached to a conventional stripper machine and harvested.

There are now some modifications to the finger fronts coming onto the market, as well as new styles of machines capable of preforming harvest. Figure 4 indicates one available modification is the use of a baton reel consisting of nylon brushes, rather than two steel beaters. The purpose of the nylon brushes is to constantly clear the fingers of lint and then to direct the lint into the auger. The nylon bristles used on the baton are similar to those found in the heads of conventional stripper machines. The bristles are highly durable and rarely break off according to grower experience.

Figure 4 : Cencorp Boll buster front with the nylon baton reel

Once the lint is in the throat of the front the machine, the lint enters the gin on the back of the stripper as per normal. This front has modifications in the throat also to assist the flow of the lint into the gin saws. The front also has the ability to tilt side to side like most of the fronts, except it has the additional forward and backward action. The benefit of this hydraulic action is to allow the operator to manually adjust the front so it can handle crops of varying height. As a crop becomes taller and / or higher yielding, the angle on the fingers is increased to assist in the feeding of lint into the auger.

The most radical change in UNR picking is the availability of a unit called the Ultra Narrow Row Harvesting System®. A Company called CENCROP® makes this unit. The same company developed the baton style front previously mentioned. With this unit, the front is still a finger style harvester, but it attaches directly onto the linkage unit of a bi-directional tractor. A suction hose then connects the harvesting front to a towable trailer. This trailer consists of a gin which is fitted on the draw bar system of a boll buggy, or the alternative option, is to deposit the lint into a towable mini module builder, (refer to figures 5 and 6). This mini module builder is capable of producing small modules of 8 by 14 feet in size. These modules are stackable and are left in the field, not unlike large hay bales. For transportation, modules can then be lifted using a set of tractor forks onto a module truck with a flat bed. In general the truck can carry two modules per trip. The overall load on the truck would be comparable to one Australian module. The system can be fitted to a normal tractor out the front of the cabin. However a linkage unit needs to allow the front attachment and visibility of the harvest fingers is not as great as the bi-directional attachment.

Figure 5: Tractor mounted Cencorp System   Figure 6: Trailing module builder

The big advantage of this system is the whole picking process is possible with one person. An attractive option in areas where yield potential is low (1 bales/acre) and harvesting costs are a major component of the overall production expenditure. With harvesting cost contributing significantly to the production cost there is the additional benefit of possibly picking the crop with a single pass. Rather than the traditional double pick as practiced in certain areas of the USA.

In Australia the major limitation at picking has been the gin capacity on the stripper. This is certainly prevalent in crops where the yields are 3 + bales/acre. From the information I could gather at field days this Cencorp® system would also struggle with these yield potential's. Therefore the concept of a one-person harvest is a novel one. The only possible areas that this system may be suitable are in the extremely marginal / low input production areas yet to have cotton production. However, if this unit had an increase in the gin capacity, then the system has real potential. For the record, the Cencrop Ultra Narrow Row Harvesting System® cost approximately $85,000 US (excluding the tractor).

9. Lint Quality

The textile industry has raised major concerns with Ultra narrow row cotton in regards to the quality of lint produced and it's subsequent suitability for fabric production. This concern has been raised over the use a stripper style fronts which tends to produce extra trash and bark in the seed cotton sample. Also, due to the extra cleaning required to remove this trash, millers are concern with the nep counts it may produce. Despite the fact that neps are not a dockage item at this stage.

Dr Michael Buschermohle from the University of Tennessee and Dr William Mayfield (Cotton Program Leader - USDA, CSREES), presented their findings on this issue at the Milan No-till Field Day. Conventional and UNR cotton were assessed for ginnability and quality. Seed cotton samples were randomly selected from 10 UNR and 10 conventional fields. The collected lint was from a range of stripper machines and spindle pickers. Results indicated that a stripper's harvesting basket on average contained an extra 700 pounds of trash when compared to a spindle picked basket. Once this cotton arrives at the gin , the operators needed to spend more time processing the UNR module to get an acceptable lint sample. For this experiment by Dr Michael Buschermohle, separated the modules from both the farming systems and processed each module based on it's individual needs. That is UNR modules received more trash cleaning compared to the conventional modules. Therefore ensuring that the conventional cotton was not over cleaned and the UNR resulted in a fair sample. To achieve an acceptable sample, the conventional cotton required one lint and burr/ stick cleaners. Where the UNR cotton required an additional burr / stick cleaner and two lint cleaners. Therefore, the UNR cotton required extra cleaning which reduces the through put in the gin and this has raised the issue of possibility charging the growers an additional ginning cost.

Once the UNR cotton was ginned, the results indicated a lower turnout percentage of 29.8%. This reduction was due to the extra ginning to remove the extra trash that was delivered. Especially since the turnout is calculated on the module weight across the delivery weigh bridge. Therefore, the more trash the grower delivers in the module, then the lower the possible turnout percentage. Following the processing of the UNR and conventional samples these were analysed for a foreign matter percentage and quality aspect. Results are outlined in table 1.

Lint was sampled and tested using a HVI machine at the USDA pilot spinning Laboratory in Glemson , South Carolina. Of the 10 UNR cotton samples tested, only one recorded a "barky" level. With all quality aspects registering as acceptable and comparable to conventional cotton samples. Due to the extra processing steps that was required with the UNR cotton, the lint had a higher count of neps. However, ALL nep levels in both systems were commercially acceptable.

The results of this experiment indicate if UNR cotton is grown, harvested and ginned properly, then the resulting lint sample will be comparable to that of conventional cotton. To remove the stigma associated with UNR cotton, growers are advised by researchers at field days to form strong links with their ginning body to ensure the seed cotton is properly processed. In the USA there is variation in the ability of gins to handle trash. This variation is usually associated with the gin stand age. Those gins that have the ability to process lint with higher trash contents are considering remuneration from the UNR growers for the extra processing. This needs to be discussed between the grower and the ginners prior to sowing of the UNR crop.

Table 1:

Average Foreign Matter and HVI Classification for Conventional and UNR Cotton from 10 Experiments and Field Demonstrations across the Mid-South and Southeast United States of America : 1998

Foreign Matter	**Conventional**	**UNR**
Initial %	7.8	20.9
Feeder %	3.4	4.8
Lint %	2.1	1.8
Turnout %	34.9	29.8
Classification	**Conventional**	**UNR**
Leaf Score	2.9	2.8
Micronaire	4.5	4.4
Length (inches)	1.08	1.07
Strength (gram/tex)	28.9	29.0
Short fibre (%)	8.6	9.4
Neps (No/gram)	277	397

Reference: 19th Annual Milan 1999 No-Till Tour Report, Tennessee July 22nd 1999

10. Alternative Ultra Narrow Row Cotton Production System

10.1. Twin Row Cotton

Dr Bill Weir (University of California) and Dr Owen Gwathmey (University of Tennessee) are assessing the viability of a modified version of Ultra Narrow Cotton. This system is referred to as Twin Row Cotton (TRC). This style of UNR cotton consists of a 60 or 80 inch beds having 2 planter lines sown 7 inches apart along the traditional planting line. Therefore, each bed still has 4 rows but there is a gap in the centre of the bed like conventional cotton. The aim of the system are the same as the UNR cotton, except this system tries to achieve earliness by utilising existing precision planter and more importantly spindle harvesting mechanisms.

Growth regulators such as Pix® still play an active role in the management of this style of crop. Besides the row configuration difference, the other major difference for TRC is the harvesting component. The twin row system only requires normal defoliation and is harvested with a conventional spindle picker. This is possible since the two 7 inch rows, if managed correctly, will fit into one spindle head of a picker. The gap between the spindle head opening should be 9 inches. Researchers experimenting with this system, suggested that a CASE® machine may be the preferred spindle picker, since it has the capabilities of picking both sides of a cotton bush. As yet this theory has to be quantified by the researchers involved.

In production costs, Dr Bill Weir measured a saving of $50-60/acre in California when the twin row system was compared to the conventional 30 inch program. This saving was a result of reduced inter row cultivations of the beds since the canopy closure was quicker than the conventional cotton. Allowing weeds to be controlled by the canopy shading effect. Yield results from the 1998 season revealed a 8 ½ % increase and 1 week earliness in the twin row system when compared to the standard 30" cotton on beds. Since the completion of the study tour I have had word from Dr Weir, stating a yield advantage was achieved also in the 1999 crop. This crop resulted in a ¼ bale/acre improvement with this system compared to the conventional cotton produced.

Figure 7 : Twin Row Cotton (LHS) Vs Conventional (RHS) at Milan Tennessee.

Mr Dan Burn is the manager of a farm called "San Juan Ranch" in California. He has also tried the twin row system and his comments were nothing but encouraging. The biggest advantage to Mr Burn was the twin row system achieved earliness but not the extra trash associated with stripper picked UNR. The trash issue was of major concern to Mr Burn, since the local area gin was a very old gin and did not have the capacity to handle the trash component associated with stripper picked cotton. Therefore, a system that gave him some potential earliness and is still harvested using his spindle pickers was more attractive than other UNR systems. Mr Burn's twin row experiment had a plant population of 100,000 plants/acre (247,000 plants/ha). With each plant slightly staggered down the plant line to ensure better light interception by the individual plants.

Dr Owen Gwathmey, is also conducting research in Twin row systems at the "Milan Research Station", Tennessee. During the study tour, Dr Gwathmey showed the group the Twin row system which revealed row closure to be more advance than the cotton on 1 metre spacings. At this site, Dr Gwathmey is testing various plant populations and growth regulator strategies that he believes are potentially suitable to this system in Tennessee. The basic planting configuration is the same as Dr Bill Weir, with two rows planted 7 inches apart. The only difference to the California twin row is Dr Gwathmey's system is sown on 80 inch beds (2metre beds). Final yield results were not available while we visited.

In both research plots, Dr Gwathmey and Dr Weir have sown the crop with a modified Kenzie planter. The planter has two sets of planter units on separate tool bars to result in the desired 7 inch row spacings in one pass. The availability of a planter to sow on this configuration appeared to be limited in literature and field days with the only suggestion of a commercial planter from the Monosem Company. However, during the study tour I never had the opportunity to speak to any growers that had used this machine.

11. Implications to the Australian Cotton Industry.

11.1 Equipment:

This study tour confirmed that if ultra narrow cotton is to progress both in the USA and Australia, then engineering solutions need to be developed for the problems it faces. The first step is to develop a cost effective multipurpose precision planter. A planter of this nature would ensure seed accuracy both within and across the plant line. As, field uniformity is a critical component in extracting earliness from this system. Secondly, the harvesting of the crop requires more development. The current system used in Australia is taken directly from the United States, where the yield potential's are lower than the current Australian experience. The main disadvantage facing Australian producers is the inability to handle the large volume of lint through a stripper machine. This lint volume is physically unable to flow evenly across the gin saws and thus it is not properly ginned during harvest. Not only are there blockages within the gin but also physical blockages in the actual finger front. The finger fronts appear to be blocking when the crop has a large robust stem, a result of a non uniformly spaced crop. In the USA, plants are very small and thin stemmed in appearance. This is why the USA experience with finger fronts has not been so limiting as the Australia's experienced. In high yielding crops the harvesting speed is also reduced to allow the gin to handle the lint volume. The problem in a high yielding crop is therefore the gin's capacity not the finger front. From my observations, there was no commercially available equipment in the USA that is capable of handling 3 bales +/acre crops. This is based on the observations that most finger fronts appeared to be very similar in design with only minor modifications, such as baton reel rather than beaters guides to direct the cotton to the auger throat.

11.2 Ginning

Reports from the USA, are indicating that UNR seed cotton should be ginned through an extra burr / stick cleaner and then through 2 lint cleaners (see table 1). This processing resulted in a lower turn out percentage but the quality of the cotton is adequate for milling. A positive finding for the textile industry, who have concerns over trash grades in UNR cotton. However, to ensure this processing does occur, growers and ginners are encouraged to form a strong working relationship.

11.3 Twin Row Cotton

This potential system was certainly an unexpected surprise when we arrived in America. This system has real potential provided it can deliver the earliness component similar to traditional UNR cotton. The most attractive factor about this system is the ability to pick the cotton using a spindle picker, which removes the stigma that is associated with UNR stripper picked crops. I have already communicated with American researchers since I have returned to Australia in which I have established a replicated experiment comparing conventional cotton to twin row cotton. Hopefully this system will enhance production in the shorter season areas with only minor adaptations need to the current farming practices.

12. Final Comments

This study tour has certainly enhanced my understanding of UNR cotton and the American cotton production systems. I have established a very good information network with fellow extension officers and researchers in the USA. These communication channels have already been used since I have returned to Australia. The information exchange will benefit the growers in the Upper Namoi Valley and myself as the Cotton Industry Development Officer for the valley. The future for UNR cotton in Australia I feel is overall very positive, despite the challenges it faces. As with any new or revamped system there will always be a steep learning curve for those involved. This curve is one I feel the growers of Australia will meet and exceed, provided Australian researchers assist the growers of UNR cotton by addressing the challenges at hand.

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