Davco Journey Into Precision Farming

Davco Controlled Traffic System at 3 Metres

Sugarcane Row Spacing Standard

By
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DAVCO FARMING
Australia
29th MARCH 2006
I wish to start my presentation with a brief overview of:

• Australian sugarcane industry
• the Burdekin Region
• Davco Farming operation
Overview of Australian Sugarcane Industry

AREA – 480,000 hectares of sugarcane
AVE. TONNES/ha - 93
CCS (SUCROSE) AVG 13.4 CC’S
TOTAL TONNES SUGAR = 37,000,000
ANNUAL RAINFALL – 800-4000mm
US$ 1 = AUST $ 1.33
FARM LABOUR COST = $US21/hr
BURDEKIN REGION

AREA – 90,000 hectares of sugarcane

AVE. TONNES/ha - 120

CCS (SUCROSE) 15.0%

FULL IRRIGATION

TOTAL RAINFALL – 900mm
Davco Farming

• Sugarcane Enterprise in Burdekin River Irrigation Area
• 70 km south of Townsville, Queensland
• Latitude 19.6 South
• Annual rainfall 900mm (80% Dec-March)
• Started cane production 1987
• 2100 ha cultivated - fully irrigated by furrow
• Crop irrigation requirement 9 to 10 ML/ha/anum
• Crop production 224,000 tonnes at 15% sucrose
• Cane yield 136 t/ha (2004)
I have divided my presentation into 3 parts

1. Davco Farming’s journey into precision farming

2. Davco Controlled Traffic (CT) System of cane growing @ 3 Metres


Achieving a common row spacing will assist manufacturers to supply us with the most effective harvesters and hauling equipment.
In each of my 3 presentations today, I have inserted a large Reference Number in the top right corner of each photo or sketch.

Please, if you desire more explanation, write a list of EACH NUMBER as we go along, so that you can ask me to elaborate during QUESTION TIME.
Why ???

These were the MAJOR CATALYSTS

• TO REDUCE SOIL COMPACTION
• TO REDUCE CANE STOOL DAMAGE DURING HARVEST
• VARIABLE SOILS REQUIRING VARIABLE TREATMENTS
• TIMELINESS OF AGRICULTURAL OPERATIONS
• TO MINIMIZE SOIL GOING TO THE MILL FROM MECHANICAL HARVESTING OPERATIONS
WHAT TECHNOLOGY WOULD BE REQUIRED?

• HIGH ACCURACY TRACTOR GUIDANCE TO ALLOW FOR CONTROLLED TRAFFIC

• GLOBAL POSITIONING SYSTEM (GPS) EQUIPMENT AVAILABLE AT AN AFFORDABLE PRICE

• TECHNICAL SUPPORT BUSINESSES TO INTRODUCE AND MAINTAIN THIS EQUIPMENT
PRECISION FARMING POSSIBILITIES

Satellites

Yield Mapping

Guidance

Weed Mapping

VRA

Leveling
COMPACTION FROM CURRENT EQUIPMENT

JOHN DEERE 9400

JOHN DEERE 8400

IRVIN SPRAYER

CAMECO CHW2500

UD TRUCK
Davco Journey into Precision Farming

FEBRUARY 1993 - The FIRST STEP

• Purchased an AUTO-STEERING KIT in California USA
• Fitted to John Deere 4755 FWA
• Got caught in it and broke my jaw

This incident slowed me down temporarily
Davco Journey into Precision Farming

NOVEMBER 1995

• SIGNED AN ORDER WITH CATERPILLAR TO PURCHASE A CHALLENGER 55 IF IT COULD BE DELIVERED WITH THE RUBBER BELTS AT 3 METRE SPACING

FEBRUARY 1996

• FINANCED AND WORKED WITH MY NEPHEW DR GRAEME COX, TO DEVELOP A YIELD MAPPING SYSTEM FOR A SUGARCANE HARVESTER
MARCH 1996

• PURCHASED JOHN DEERE ROW-TRACK GUIDANCE SYSTEM WHICH USED SENSORS SLIDING DOWN THE FURROW WALL TO STEER THE IMPLEMENT

JULY 1996

• TRAVELED TO PRECISION AGRICULTURE CONFERENCE IN, MINNESOTA USA LOOKING FOR LATEST TECHNOLOGY IN TRACTOR GUIDANCE AND YIELD MAPPING

AUGUST 1996

• INSPECTED AND DROVE PROTOTYPE CAT CHALLENGER 55 WITH BELTS AT 3 METRE SPACING AT TESTING GROUNDS IN CALIFORNIA USA
Davco Journey into Precision Farming

OCTOBER 1996

• Dr GRAEME COX produced the WORLD’S FIRST YIELD MAP of SUGAR CANE using data from a mass flow sensor in the harvester
Yield Map

Field 7a  1996
DAVCO FARMING
Burdekin

Sugar Cane Yield (t/ha)
10 - 20
20.1 - 40
40.1 - 60
60.1 - 80
80.1 - 100
100.1 - 120
120.1 - 140
140.1 - 160
160.1 - 180
180.1 - 200
200.1 - 220
220.1 - 240

Total Yield: 14287.6 t
Average Yield: 122.6 t/ha

By Graeme Cox
16/10/1996
OCTOBER 1997: CATERPILLAR shipped the first Challenger 55 with belts at 3 Metre spacing to Australia for delivery to Davco Farming.
COMPACT REDUCTION
PROGRESS

CAT
CHALLENGER

IRVIN
SPRAYER

CAMECO
CHW 2500

UD TRUCK
JULY 1998

• Traveled to PRECISION AGRICULTURE Conference in Minnesota continuing the search for the latest in tractor guidance

AUGUST 1998

• Returned to Australia discovered an Australian group who had succeeded in developing a guidance system on a CAT Challenger 55 with lateral accuracy of +/- 20mm

SEPTEMBER 1998

• Purchased the first GPS auto steer guidance system in the Australian sugar industry (BEELINE)
Davco Journey into Precision Farming

OCTOBER 1998

• Discussions with Cameco regarding the development of a 2 Row Harvester

FEBRUARY 1999

• Purchased two low cost – non GPS - NCEA AUTO TRACK guidance systems to fit JD 7600 and JD 7710 wheel tractors
July 1999: CAMECO built three 2 ROW “prototype” harvesters, one for FLORIDA, one for LOUISIANA and one for Davco Farming.
COMPACTION REDUCTION PROGRESS

CHALLENGER

IRVIN SPRAYER

CAMECO 2 R0W

UD TRUCK
NOVEMBER 1999: Organized a team to design and construct three INFIELD CANE TRANSPORTERS with wheels at 3 Metre spacing.
June 2000: CANTRELL / CARTA delivered three new 20 tonne CANE TRANSPORTERS with wheels at 3 Metre spacing
COMPACCTION REDUCTION PROGRESS

CHALLENGER

IRVIN SPRAYER

CAMECO 2 ROW

CANE TRANSPORTER
April 2001
Spray contractor replaced TRICYCLE equipment with a 3M ROGATOR 854
TRANSITION TO 3 METRE COMPLETED
2001

CHALLENGER

ROGATOR 854

CAMECO 2 ROW

CANE TRANSPORTER
November 2001

- Performed first VARIABLE RATE APPLICATION (VRA) of soil conditioners based on sugarcane yield map
NOVEMBER 2001: INTRODUCED GPS WEED MAPS

DAVCO FARMING

Farm: Northcote
Block: 108
Year 2001
Weed Map
MARCH 2002: DESIGNED and BUILT a 4 ROW FULL STICK CANE PLANTER
<table>
<thead>
<tr>
<th>Cane Planting Rates (t/ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (Conv. 1.5 m whole stalk)</td>
<td>5.0</td>
</tr>
<tr>
<td>T2 (Conv. 1.5 m Billet)</td>
<td>12.0</td>
</tr>
<tr>
<td>T3 (DD 1.5 m)</td>
<td>****</td>
</tr>
<tr>
<td>T4 (DD 1.8 m)</td>
<td>3.1</td>
</tr>
<tr>
<td>T5 (DD 1.8 m Dual)</td>
<td>6.1</td>
</tr>
<tr>
<td>T6 (DD 2.1 m Dual)</td>
<td>5.2</td>
</tr>
<tr>
<td>T7 (DD 2.1 m Triple)</td>
<td>7.9</td>
</tr>
<tr>
<td>T8 (DD 2.1 m Quads)</td>
<td>10.5</td>
</tr>
</tbody>
</table>

**DD = DOUBLE DISC OPENER**

Source: A.L. Garside
NOVEMBER 2002

- Fitted TRIMBLE GPS guidance (20mm) to 2 row harvester
- Replaced tactile guidance with GPS (20mm) on JD 7600
- Fitted GPS 20mm guidance to Challenger MT 765
AFTER 2003

MODIFICATIONS TO 4 ROW PLANTER TO REDUCE CHOKING

TRIALED VARIOUS PLANTING DEPTHS – A COMPROMISE
JULY 2004: Fitted 3D GPS machine control to JD 9400 and SOIL SCOOP
2005 Optimum Surface Land Leveling - OptiSurf

- Land leveling using 3D machine control (GPS/Laser)
- Advantages over traditional laser leveling
  - Reduced Earthworks Cost (Aim: <$100/ha)
  - Reduced Topsoil Loss
  - Improved Infiltration & Drainage
  - Reduced Design Time (from days to minutes)
DAVCO

Controlled Traffic System at 3 Metres
Davco Controlled Traffic System at 3 Metres

System Features

• 500mm WIDE TRAFFIC LANES at 3 Metre Spacing
• 1.5 Metre UNIFORM ROW SPACING
• UNIFORM BED HEIGHT of 200mm
• GPS guided equipment ensures traffic lanes are NOT DISTURBED during deep cultivation
• DEEP RIPPED SOIL IN THE BEDS is not compacted by subsequent harvesting or hauling operations
Davco Controlled Traffic System at 3 Metres

System Benefits

- Reduced horsepower requirements
- Reduced fuel consumption
- Improved soil structure
- Increased rate of water infiltration
- Improvement in water holding capacity
- Improvement in soil health
Davco Controlled Traffic System at 3 Metres

System Benefits Continue

- GPS reduces operator fatigue
- Better herbicide performance during fallow
- Wet season rainfall is stored in the bed and not lost during ground preparation for planting
- More controllable timing of planting operation
- One pass after planter to prepare profile for harvester
Davco Controlled Traffic System at 3 Metres

System disadvantages

• Requires HIGH ACCURACY GPS (+/- 20mm) on multiple pieces of equipment

• Requires a COMPROMISE on PLANTING DEPTH
Davco Controlled Traffic System at 3 Metres

3000

1500

1000  500

TRAFFIC ZONE

MINIMAL ZERO TRAFFIC ZONE

TRAFFIC ZONE

COMPACTED SOIL = 18%
Davco Controlled Traffic System at 3 Metres

Challenger 765 + Tandem Offset 6M
Davco Controlled Traffic System at 3 Metres

RIPPER 2 TYNES + ROLLER
Davco Controlled Traffic System at 3 Metres

PARAPLOW 6 TYNES
Davco Controlled Traffic System at 3 Metres
Davco Controlled Traffic System at 3 Metres
CT RIPPER COMBO
BEDFORMER 6M  4 -1.5M BEDS
LOADING CANE PLANTS
FURROW IRRIGATION
CAMECO 2 ROW HARVESTER @ 3M

CANTRELL – CARTA TRANSPORTER 20 TONNE
The entire world sugarcane growing industry is characterised by a mismatch of row spacing and equipment wheel spacing.
THE CHALLENGE —

CANE WE FIND AN ACCEPTABLE WORLD STANDARD ROW SPACING?

CURRENT MACHINERY IS JUST TOO MUCH OF AN AGRONOMIC COMPROMISE
Davco Farming's Row Spacing experience so far

<table>
<thead>
<tr>
<th>Year</th>
<th>Row Spacing</th>
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<tbody>
<tr>
<td>1987-1990</td>
<td>1830mm</td>
</tr>
<tr>
<td>1991-1992</td>
<td>1630mm</td>
</tr>
<tr>
<td>1993-1994</td>
<td>1524mm</td>
</tr>
<tr>
<td>1995-1997</td>
<td>1600mm</td>
</tr>
<tr>
<td>1998</td>
<td>500/1000mm Dual Row</td>
</tr>
<tr>
<td>1999 Onwards</td>
<td>1500mm with 3M Harvester</td>
</tr>
</tbody>
</table>
LET US CONSIDER SOME LIKELY OPTIONS

<table>
<thead>
<tr>
<th>HARVESTER WHEEL SPACING (mm)</th>
<th>ROW SPACING (mm)</th>
<th>% SOIL COMPACTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850</td>
<td>1524</td>
<td>70 %</td>
</tr>
<tr>
<td>1850</td>
<td>1400</td>
<td>70 %</td>
</tr>
<tr>
<td>1850</td>
<td>1850</td>
<td>35 %</td>
</tr>
<tr>
<td>1850</td>
<td>500/1350 DR</td>
<td>35%</td>
</tr>
<tr>
<td>2000</td>
<td>800/1200 DR</td>
<td>30 %</td>
</tr>
<tr>
<td>2400</td>
<td>1200</td>
<td>24 %</td>
</tr>
<tr>
<td>3000</td>
<td>1500</td>
<td>18 %</td>
</tr>
</tbody>
</table>
AUSSIE 5 Feet (1524mm) ROW SPACING
6 FEET (1850mm) WHEEL SPACING

COMPACTED SOIL > 70%
THIS DESIGN CONCEPT HAS REACHED THE LIMIT OF ITS CAPABILITY

SPACERS REQUIRED TO ACHIEVE

2M WHEEL = 60mm each side

2.4M TRACK SPACE = 260mm each side
CURRENT BRAZIL INFIELD TRANSPORT SYSTEM
JUNE/04

TRACTOR

1400

1400

580

1720

490

2730

TRAILER
CURRENT BRAZIL INFIELD TRANSPORT SYSTEM
JUNE/04

TRACTOR

1400

580

1400

600

1720

1700

LATEST TRAILERS
1.850M ROW SPACING & WHEEL SPACING

COMPACTED SOIL = 35%

FEATURES

• Why 1.85 – because current harvesters are 1.83 to 1.88M

• A possible option to utilize current equipment
1.850M ROW SPACING & WHEEL SPACING

PROBLEMS:

• Less than optimum harvesting of sunlight energy
• More herbicide required
• Less than optimum plant population
• Higher soil water evaporation in plant or burnt fields
1.850M WHEEL SPACING - Dual Row

COMPACTED SOIL = 35%

FEATURES
- A possible option to utilize existing equipment
- Undesirable DUAL ROW RATIO
- Potential increase in capacity at same ground speed = 23%
1.850M WHEEL SPACING - Dual Row

PROBLEMS:

• Higher than optimum stalk numbers
• Close rows compete for sunlight – tall thin stalks
• Dual rows lodge much earlier in the growth cycle
• When lodging, the close rows fall away from each other resulting in weed growth and cane suckers
• Cane sprawled in all directions makes difficult harvest
• More cane is needed for planting operation
2M WHEEL SPACING Dual Row

COMPACTED SOIL = 32%

FEATURES

• A very good option to utilize existing equipment with some modification required

• Acceptable DUAL ROW RATIO

• Potential increase in capacity at same ground speed = 33%
2M DUAL ROW OPTION

PROBLEMS:

• Modify the basecutters on the harvester to gather rows 800mm apart

• Spacers required 70mm each side to take wheels or tracks to 2M

• Some modifications required to infield hauling equipment
2.4 M WHEEL SPACING

COMPACTED SOIL = 24%

• PROBABLY OPTIMUM PLANT DENSITY
• REQUIRES SUBSTANTIAL HARVESTER MODIFICATIONS
• REDUCED SOIL MOISTURE LOSS
• REDUCTION IN WEED GROWTH AND NECESSARY HERBICIDE
• POTENTIAL INCREASE IN CAPACITY AT SAME SPEED + 60%
3M TRACK SPACING
ROW SPACING - 1500

FEATURES
• ALLOWS > 100% CAPACITY INCREASE
• SUITABLE FOR COMMON WORLD SPACING  1.4 - 1.5 M

COMPACTED SOIL = 18%
3M TRACK SPACING

- VERY LOW COMPACTION PERCENTAGE
- LOW CENTRE OF GRAVITY OF ALL EQUIPMENT
- LOW FUEL CONSUMPTION PER TONNE
- BEST GPS GUIDANCE PERFORMANCE

PROBLEMS

- CURRENTLY NOT BUILT BY MANUFACTURERS
- SPECIALISED HAULING EQUIPMENT REQUIRED
CAMECO 2 ROW HARVESTER

• Quite complex machine
• More expertise required to operate and maintain
• Very, very productive

For ROW SPACING of 1.5M

POTENTIAL CAPACITY INCREASE + 110%

• Quite complex machine
• More expertise required to operate and maintain
• Very, very productive
FUTURE DESIGN CONCEPT

2.4M WHEEL (or TRACK) SPACING

POTENTIAL CAPACITY INCREASE + 60%
FUTURE DESIGN CONCEPT

3M WHEEL SPACING using 2.4M BASE MODULE with TRACKS, CROP DEVIDERS @ 3M

POTENTIAL CAPACITY INCREASE + 110%
The world sugarcane industry needs a modular harvester with these features:

1. Central base unit with engine, hydraulic pumps, cab, chopper drum
2. An interface at front to allow user innovations to be trialled
3. Two elevator size options
4. Spacers to allow wheels or tracks to be adjusted from 1.83-2.4M
Thank You

DAVID COX
DAVCO FARMING
AUSTRALIA
2006