

Davco Journey Into Precision Farming

Davco Controlled Traffic System at 3 Metres

Sugarcane Row Spacing Standard

By

DAVID COX

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

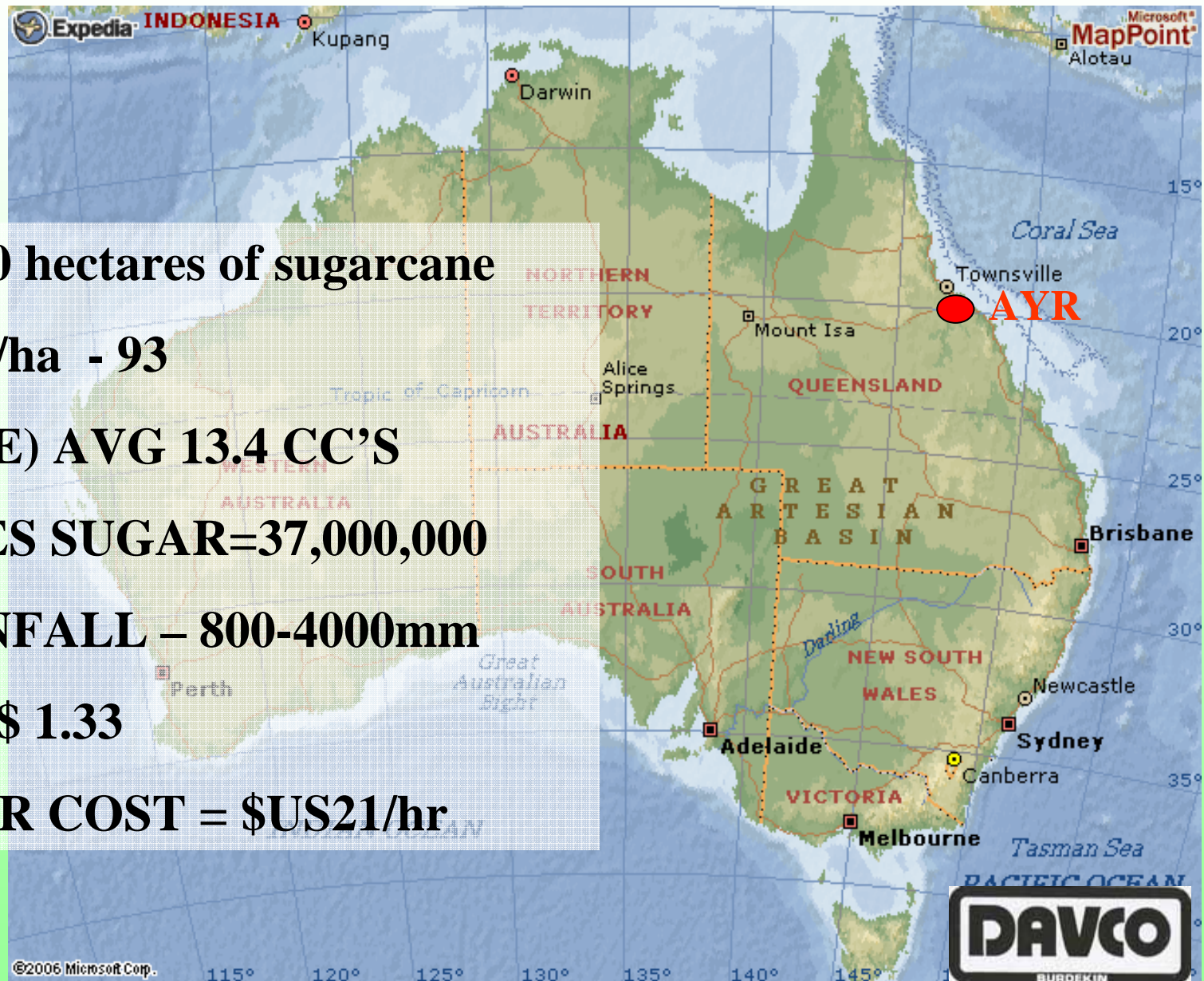
CCS (SUCROSE) AVG 13.4 CC'S

TOTAL TONNES SUGAR=37,000,000

ANNUAL RAINFALL – 800-4000mm

US\$ 1 = AUST \$ 1.33

FARM LABOUR COST = \$US21/hr



BURDEKIN REGION

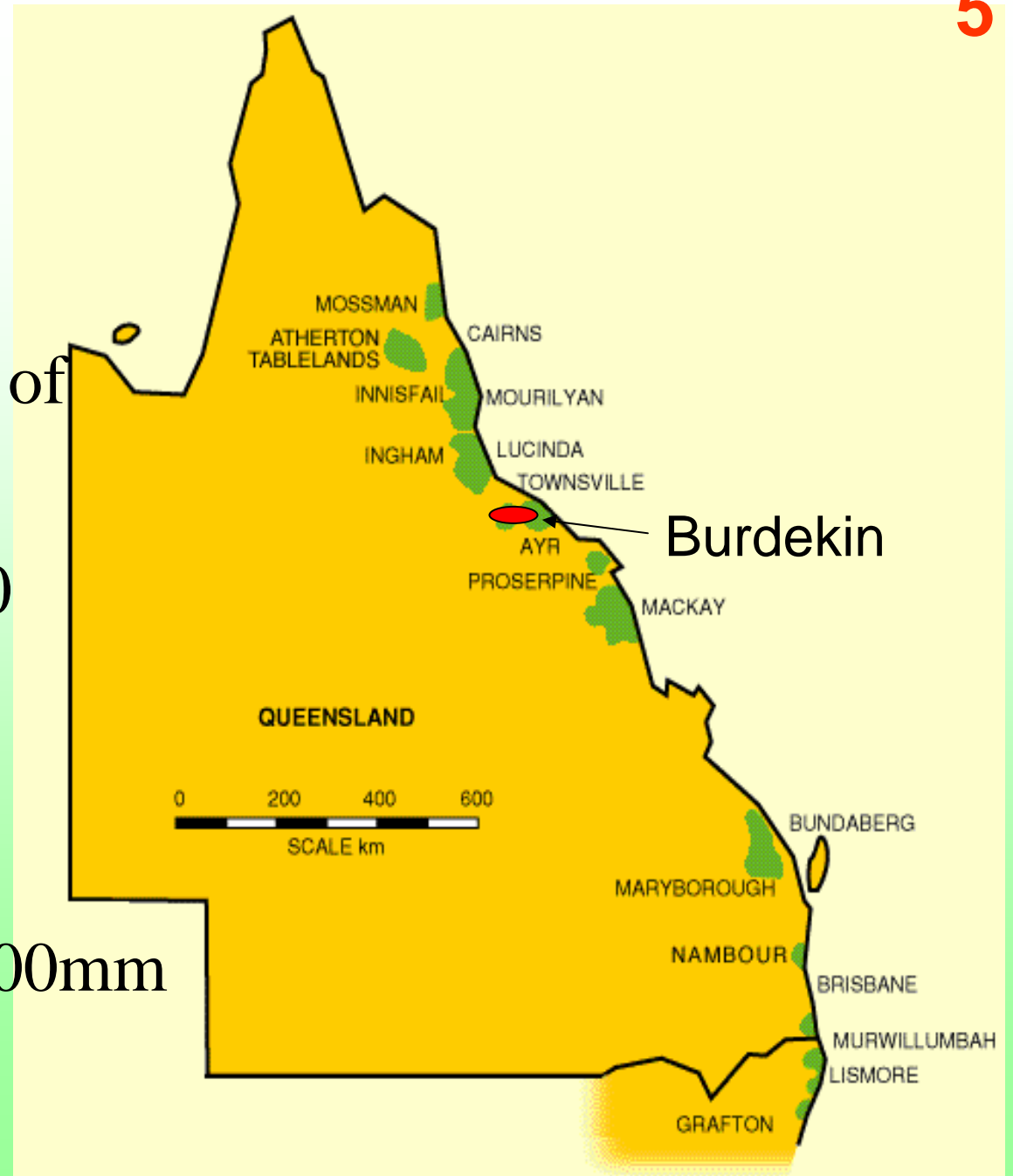
AREA – 90,000 hectares of sugarcane

AVE. TONNES/ha - 120

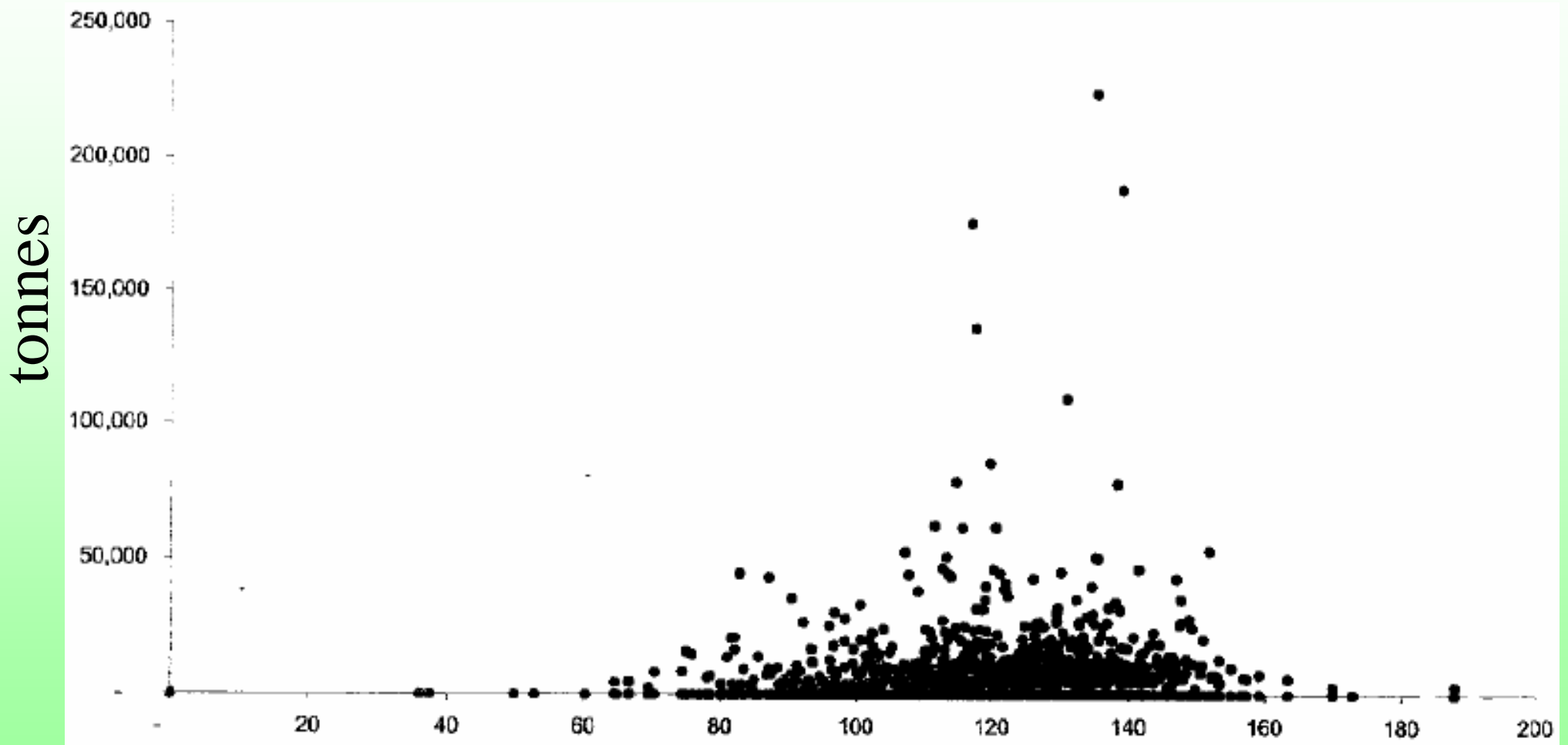
CCS (SUCROSE) 15.0%

FULL IRRIGATION

TOTAL RAINFALL – 900mm



BURDEKIN SUGARCANE PRODUCERS



tonnes

tonnes/hectare



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/ annum**
- **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
3. Recommendation for a World Standard Sugarcane Row Spacing.

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.

Davco Journey into Precision Farming 10

Why ???

These were the MAJOR CATALYSTS

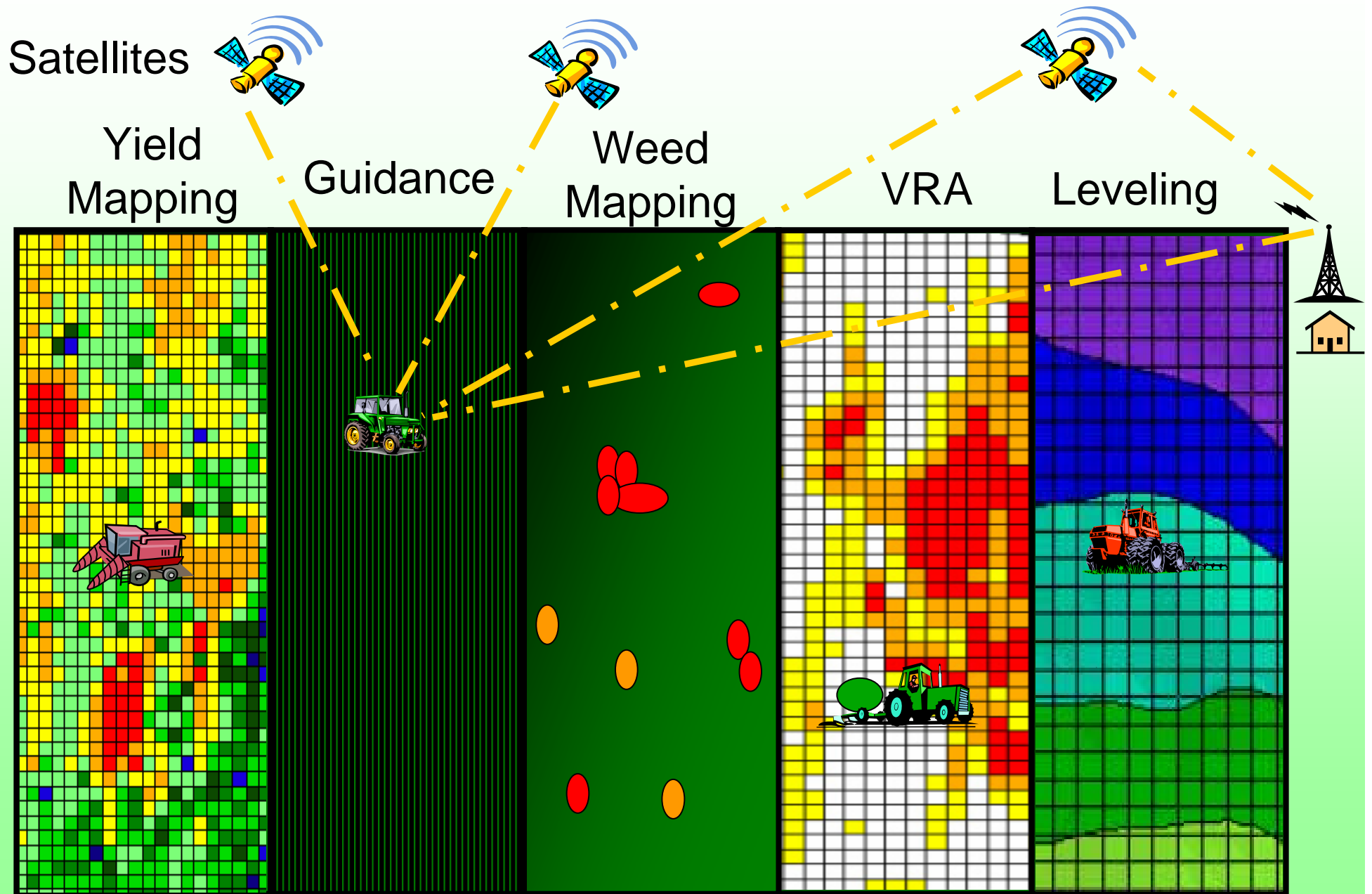
- TO REDUCE SOIL COMPACTION
- TO REDUCE CANE STOOL DAMAGE DURING HARVEST
- VARIABLE SOILS REQUIRING VARIABLE TREATMENTS
- TIMELINESS OF AGRICULTURAL OPERATIONS
- TO MINIMIZE SOIL GOING TO THE MILL FROM MECHANICAL HARVESTING OPERATIONS

HOW ???

WHAT TECHNOLOGY WOULD BE REQUIRED ?

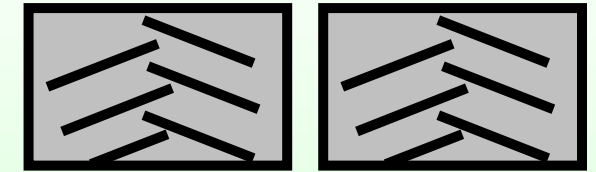
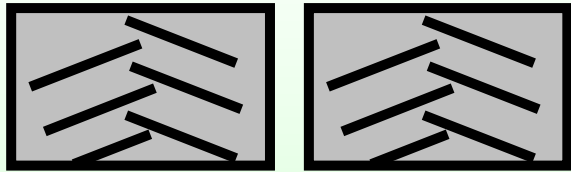
- HIGH ACCURACY TRACTOR GUIDANCE TO ALLOW FOR CONTROLLED TRAFFIC
- GLOBAL POSITIONING SYSTEM (GPS) EQUIPMENT AVAILABLE AT AN AFFORDABLE PRICE
- TECHNICAL SUPPORT BUSINESSES TO INTRODUCE AND MAINTAIN THIS EQUIPMENT

PRECISION FARMING POSSIBILITIES

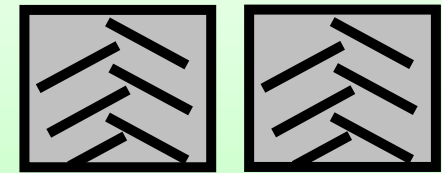
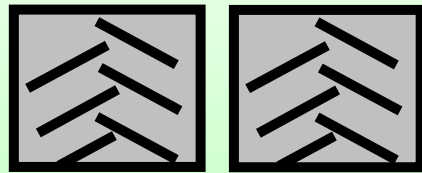


COMPACTION FROM CURRENT EQUIPMENT

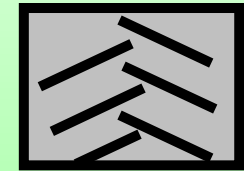
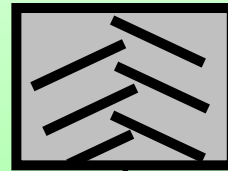
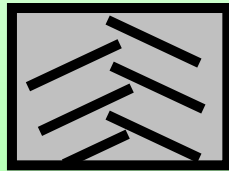
JOHN DEERE
9400



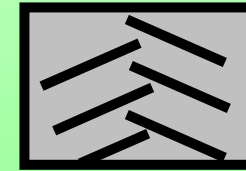
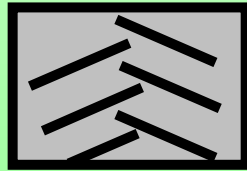
JOHN DEERE
8400



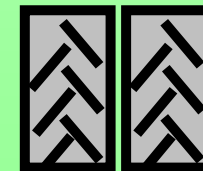
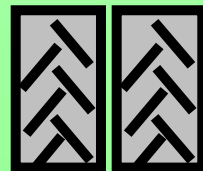
IRVIN
SPRAYER



CAMECO
CHW2500



UD TRUCK



Davco Journey into Precision Farming

14

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

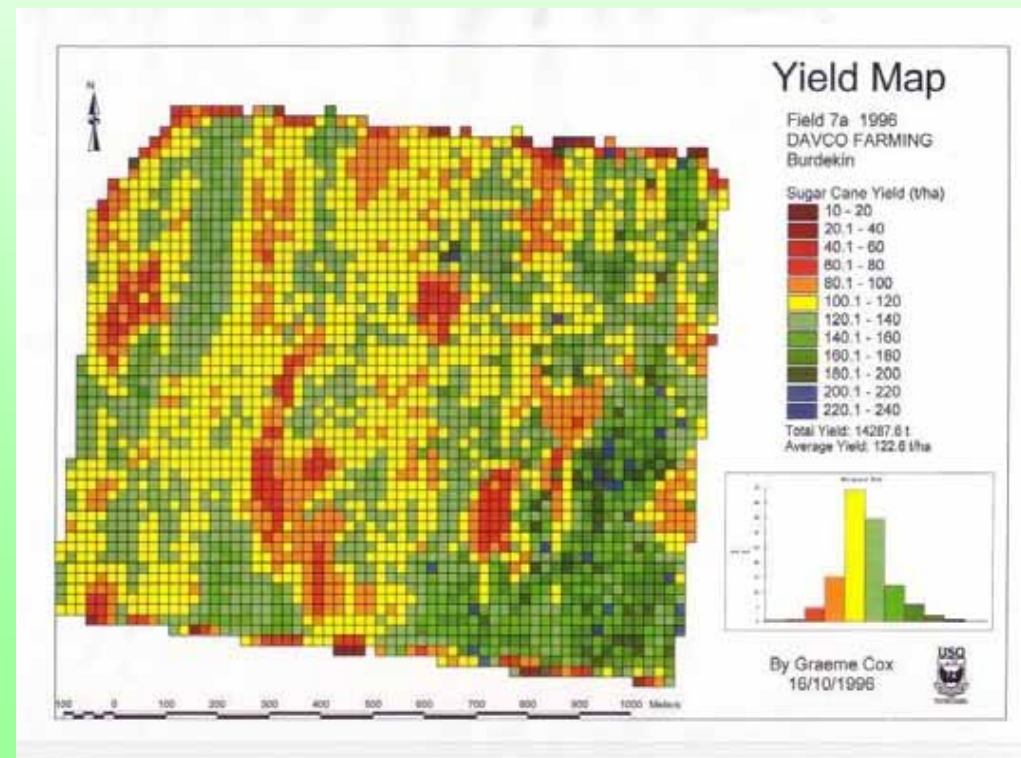
AUGUST 1996

- 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 WORLDS FIRST YIELD MAP of SUGAR CANE using data from a mass flow sensor in the harvester



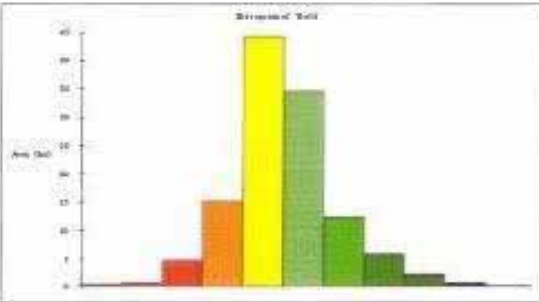
Yield Map

Field 7a 1996
 DAVCO FARMING
 Burdekin

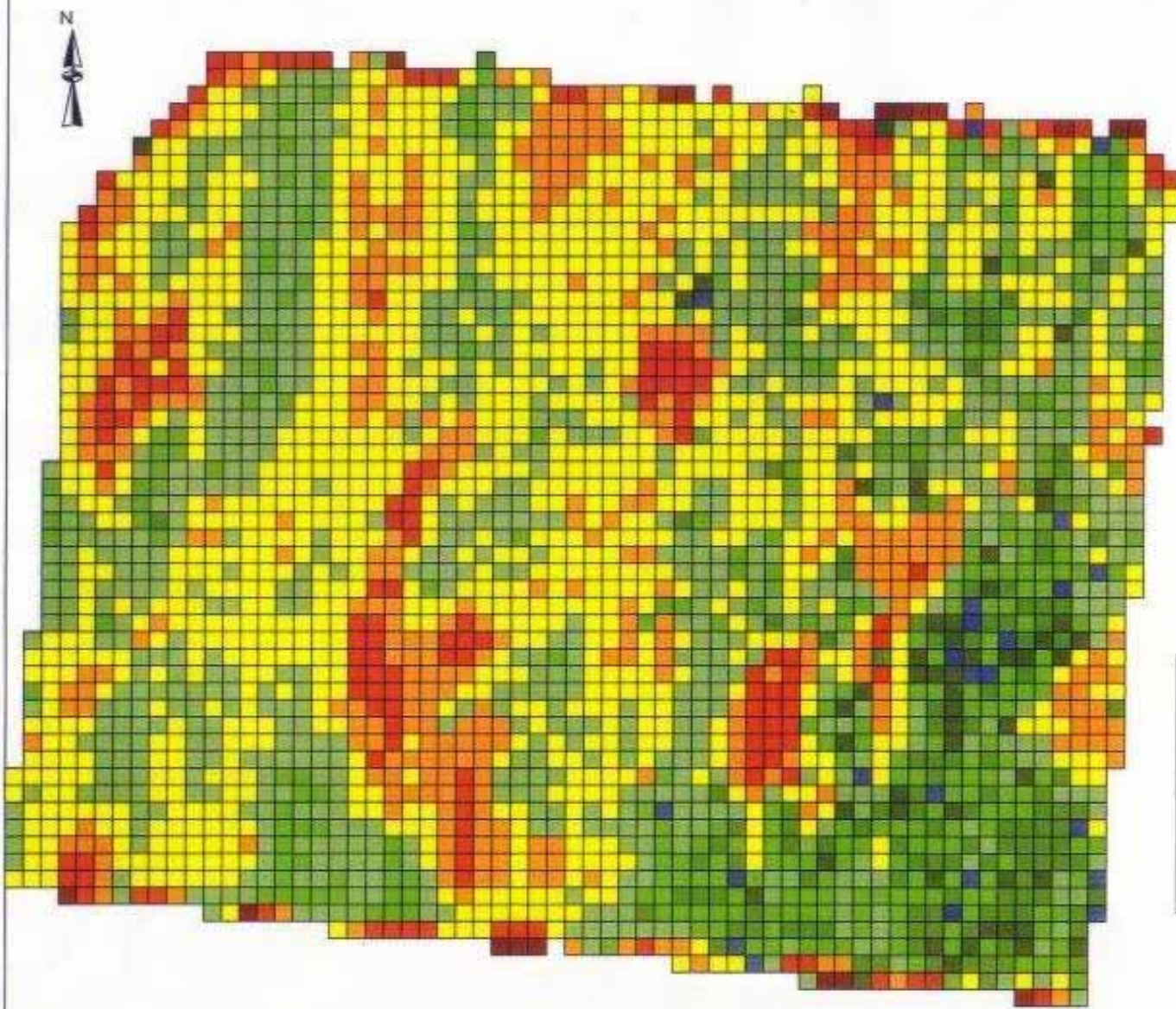
Sugar Cane Yield (t/ha)



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



By Graeme Cox
 16/10/1996

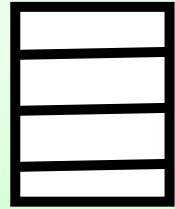


OCTOBER 1997 : CATERPILLAR shipped the first Challenger 55 with belts at 3 Metre spacing to Australia for delivery to Davco Farming

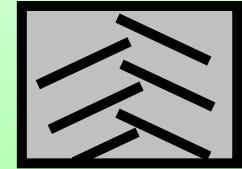
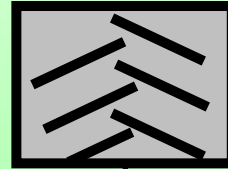
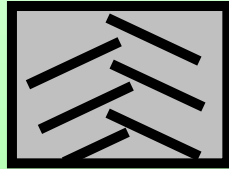


COMPACTION REDUCTION PROGRESS

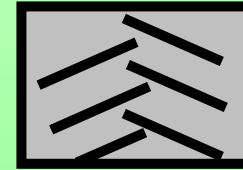
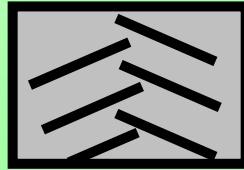
CAT
CHALLENGER



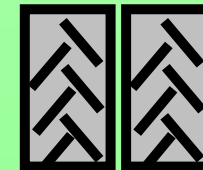
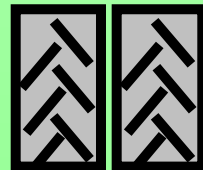
IRVIN
SPRAYER



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

NCEA AUTO - TRACK GUIDANCE

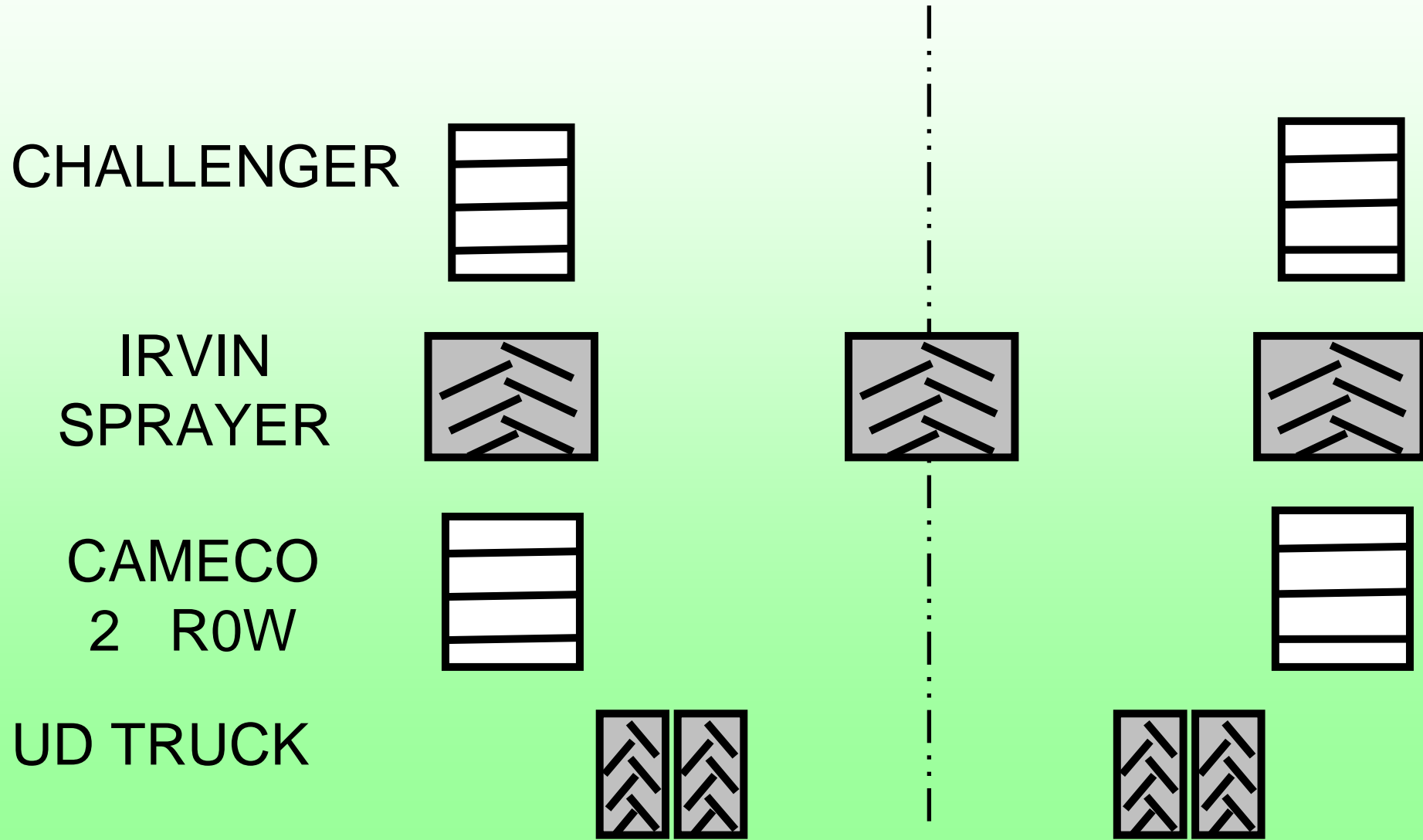


**July 1999 : CAMECO built three 2 ROW
“prototype” harvesters, one for
FLORIDA, one for LOUISIANA and one
for Davco Farming.**





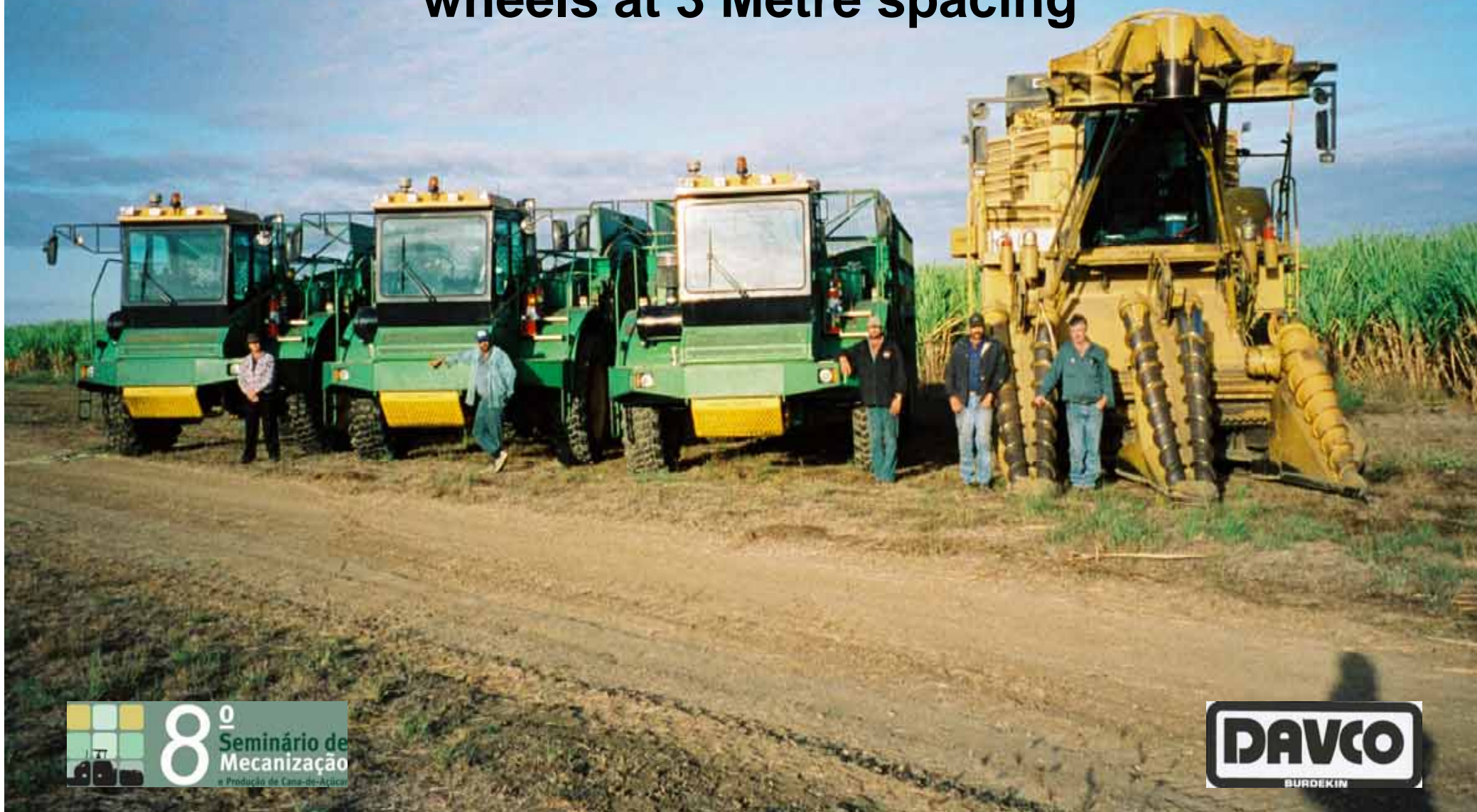
COMPACTION REDUCTION PROGRESS



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

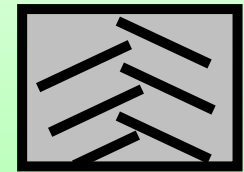
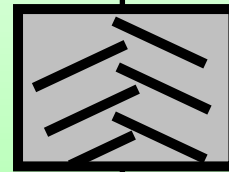
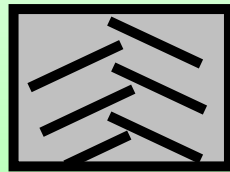


COMPACTION REDUCTION PROGRESS

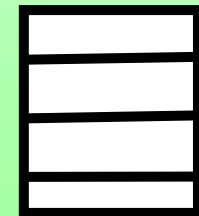
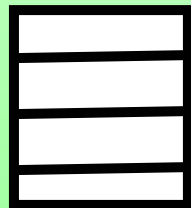
CHALLENGER



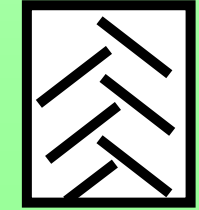
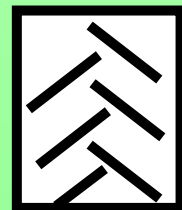
IRVIN
SPRAYER



CAMECO
2 ROW



CANE
TRANSPORTER

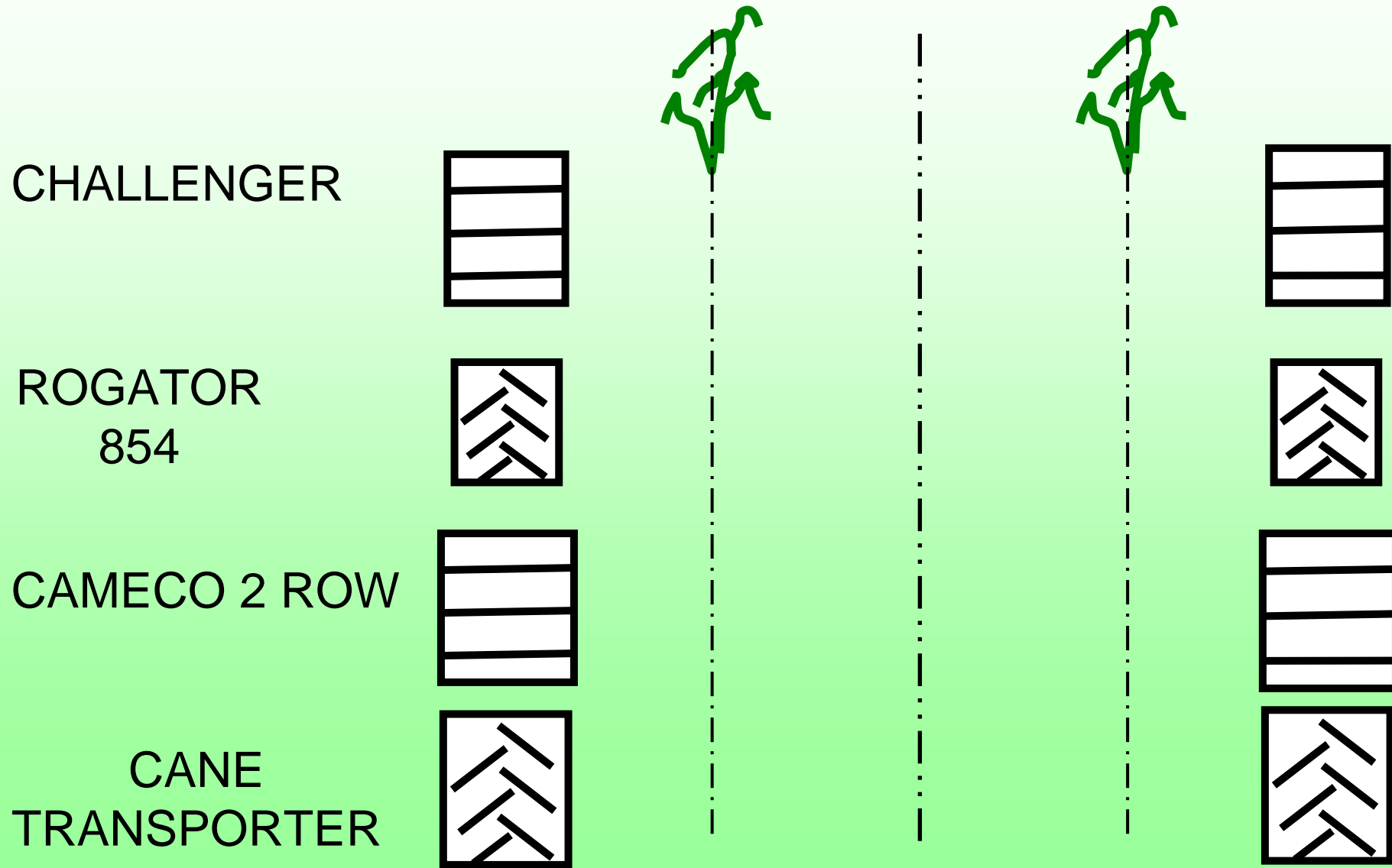




April 2001

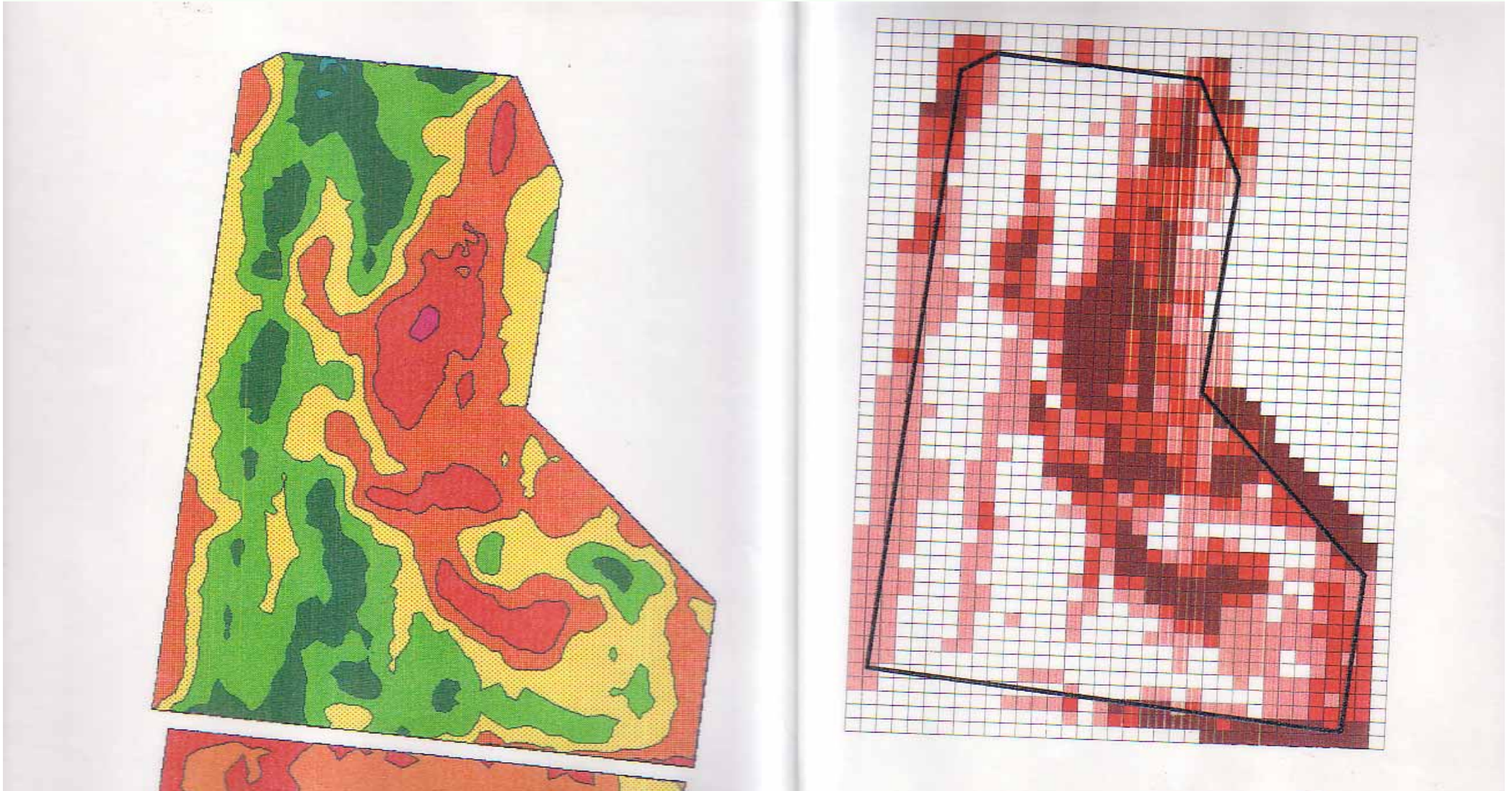
Spray contractor replaced TRICYCLE
equipment with a 3M ROGATOR 854

TRANSITION TO 3 METRE COMPLETED 2001



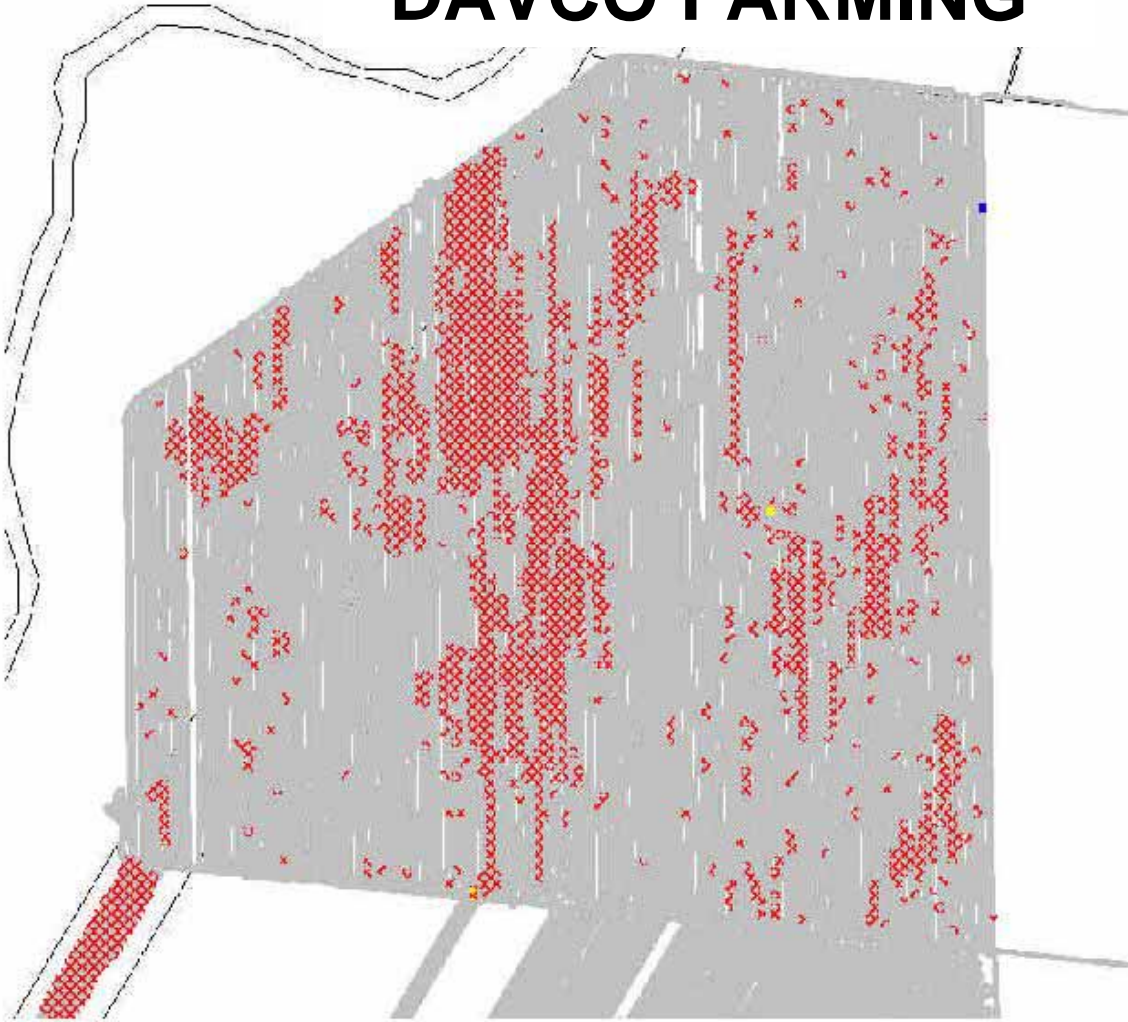
November 2001

- Performed first VARIABLE RATE APPLICATION (VRA) of soil conditioners based on sugarcane yield map



NOVEMBER 2001: INTRODUCED GPS WEED MAPS

DAVCO FARMING

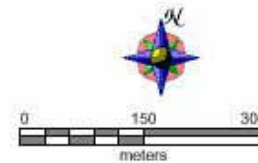


Farm: Northcote

Block: 108

Year 2001

Weed Map



MARCH 2002 : DESIGNED and BUILT a 4 ROW FULL STICK CANE PLANTER



Cane Planting Rates (t/ha)

- T1 (Conv. 1.5 m whole stalk) 5.0
- T2 (Conv. 1.5 m Billet) 12.0
- T3 (DD 1.5 m) **** 3.7
- T4 (DD 1.8 m) 3.1
- T5 (DD 1.8 m Dual) 6.1
- T6 (DD 2.1 m Dual) 5.2
- T7 (DD 2.1 m Triple) 7.9
- T8 (DD 2.1 m Quads) 10.5

DD = DOUBLE DISC OPENER



Davco Journey into Precision Farming

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**

TRIMBLE GUIDANCE ON CAMECO 2 ROW

38



Davco Journey into Precision Farming

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

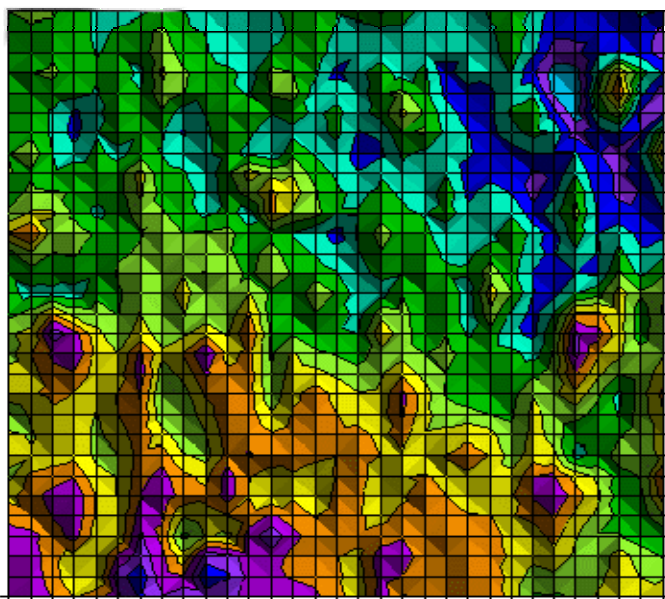


2005 Optimum Surface Land Leveling - OptiSurf

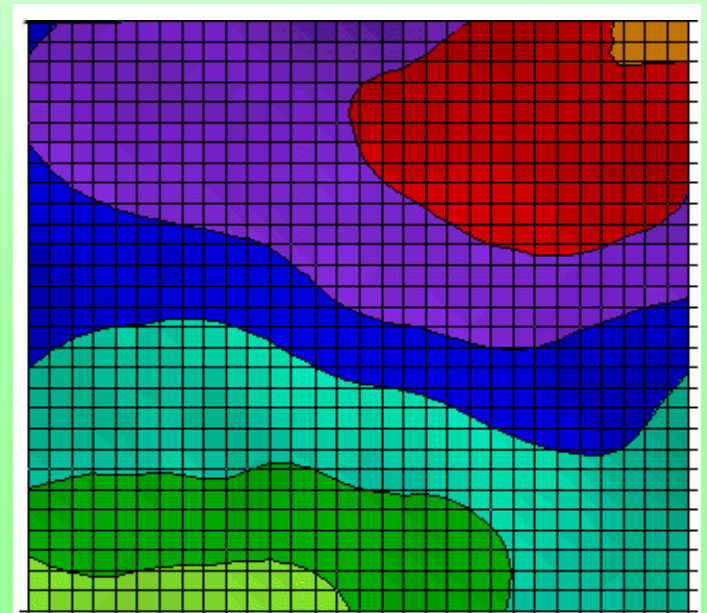
41

- 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)

From
This
Land
Surface



To
This
Opti
Surf



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

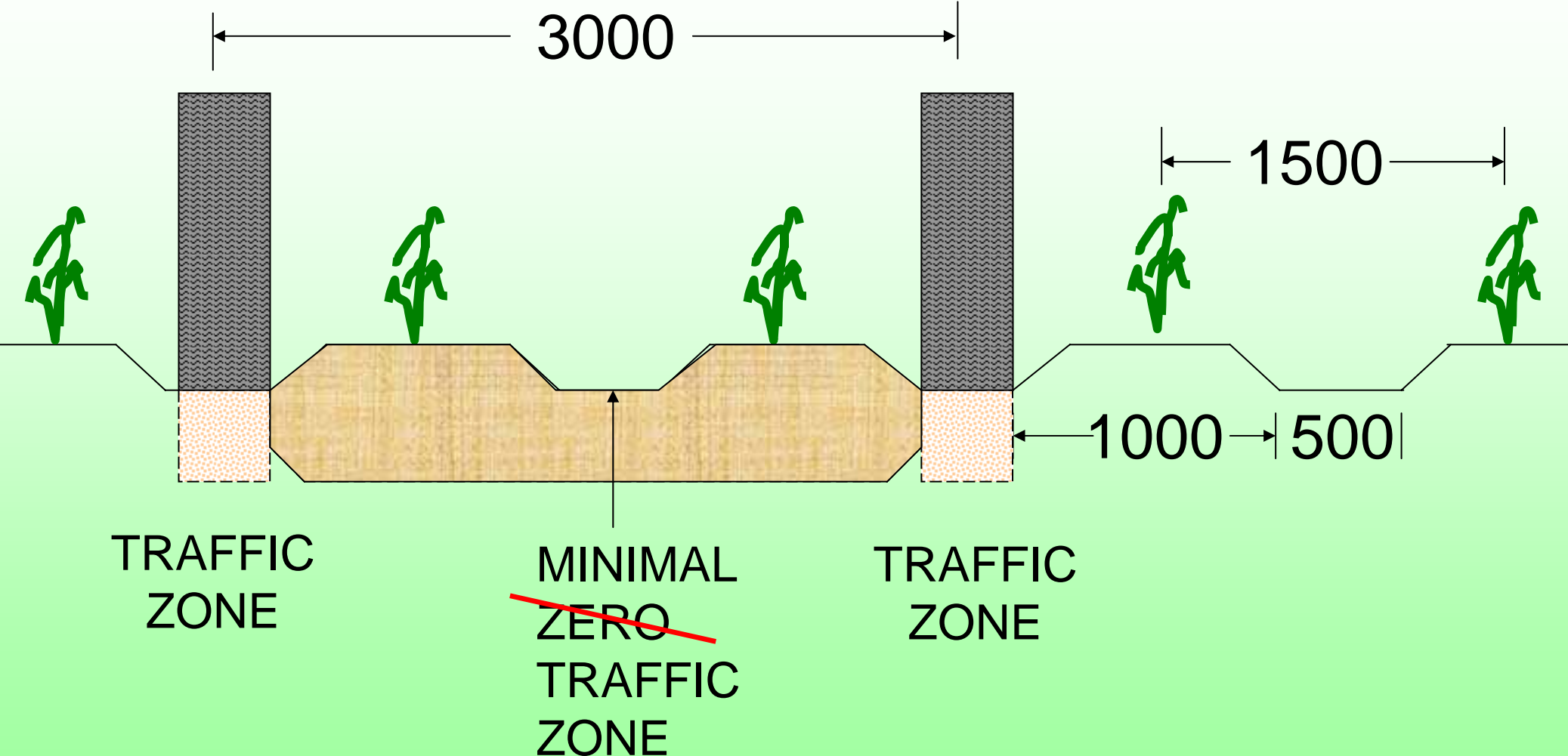
- GPS reduces operator fatigue
- Better herbicide performance during fallow
- Wet season rainfall is stored in the bed and not lost during ground preparation for planting
- More controllable timing of planting operation
- One pass after planter to prepare profile for harvester

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 47



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



Davco Controlled Traffic System at 3 Metres



Davco Controlled Traffic System at 3 Metres





CT RIPPER COMBO

BEDFORMER 6M 4 -1.5M BEDS

54



FULL STICK PLANTER 4 ROWS @ 1.5M

55







LOADING CANE PLANTS



DOUBLE DISC OPENER



FURROW IRRIGATION

60



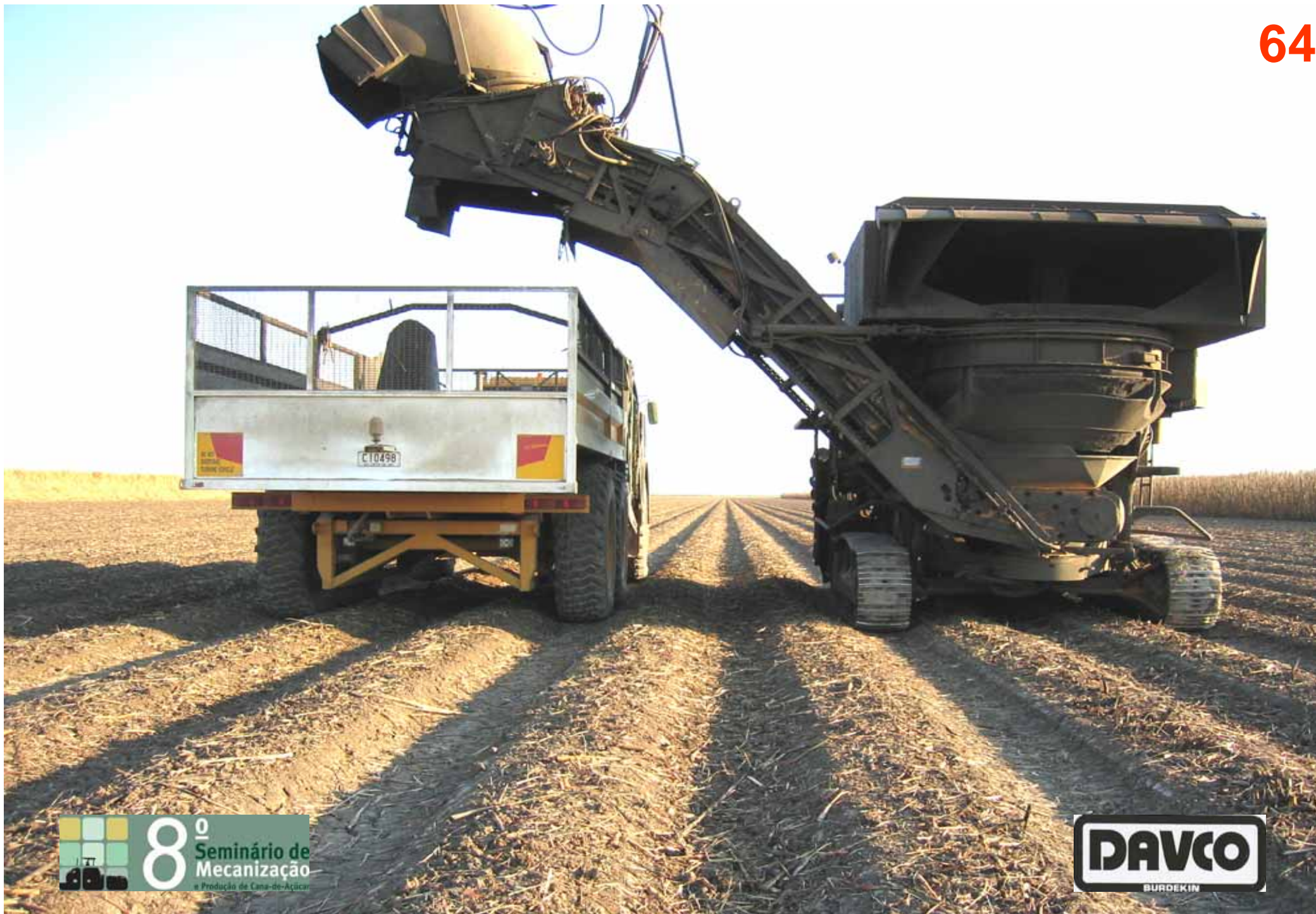
CAMECO 2 ROW HARVESTER @ 3M

CANTRELL – CARTA TRANSPORTER 20 TONNE









Sugarcane Row Spacing Standard

THE ENTIRE WORLD SUGARCANE
GROWING INDUSTRY IS CHARACTERISED
BY A
MISMATCH OF ROW SPACING AND
EQUIPMENT WHEEL SPACING

THE CHALLENGE —

CAN 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

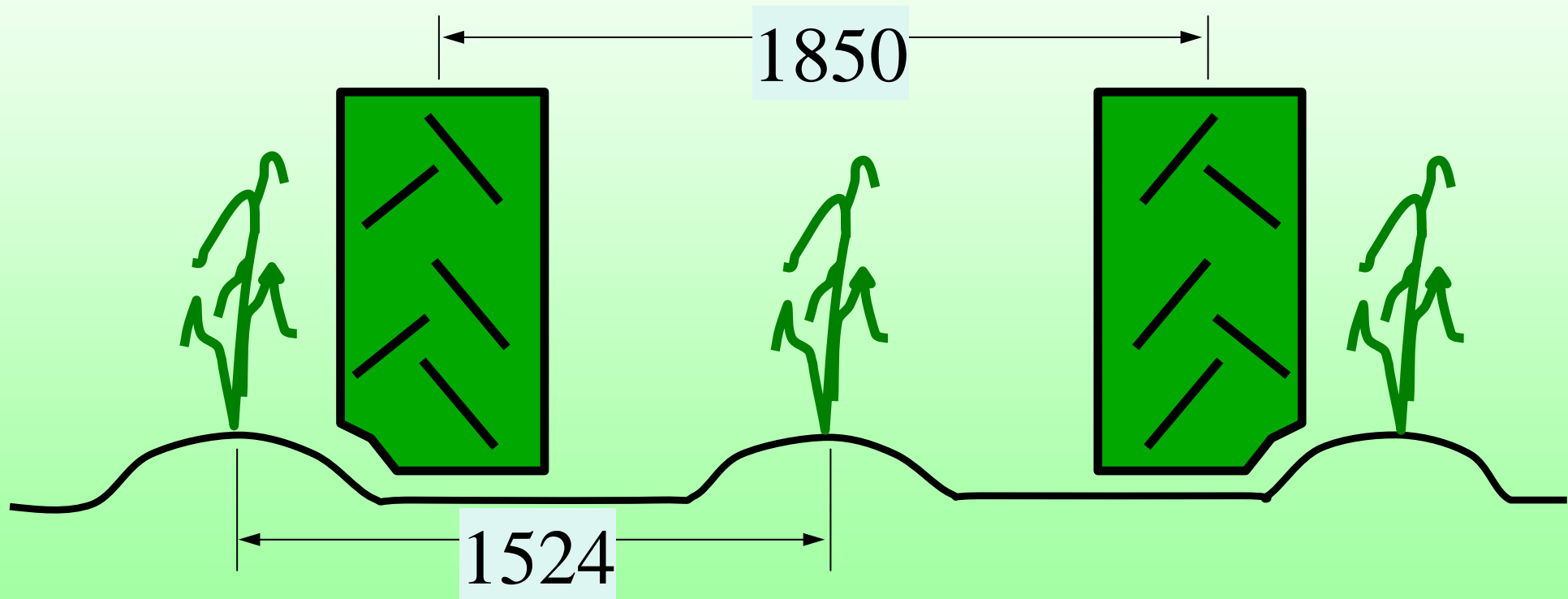
1987-1990	1830mm
1991-1992	1630mm
1993-1994	1524mm
1995-1997	1600mm
1998	500/1000mm Dual Row
1999 Onwards	1500mm with 3M Harvester

LET US CONSIDER SOME LIKELY OPTIONS

HARVESTER WHEEL SPACING (mm)	ROW SPACING (mm)	% SOIL COMPACTED
1850	1524	70 %
1850	1400	70 %
1850	1850	35 %
1850	500/1350 DR	35%
2000	800/1200 DR	30 %
2400	1200	24 %
3000	1500	18 %

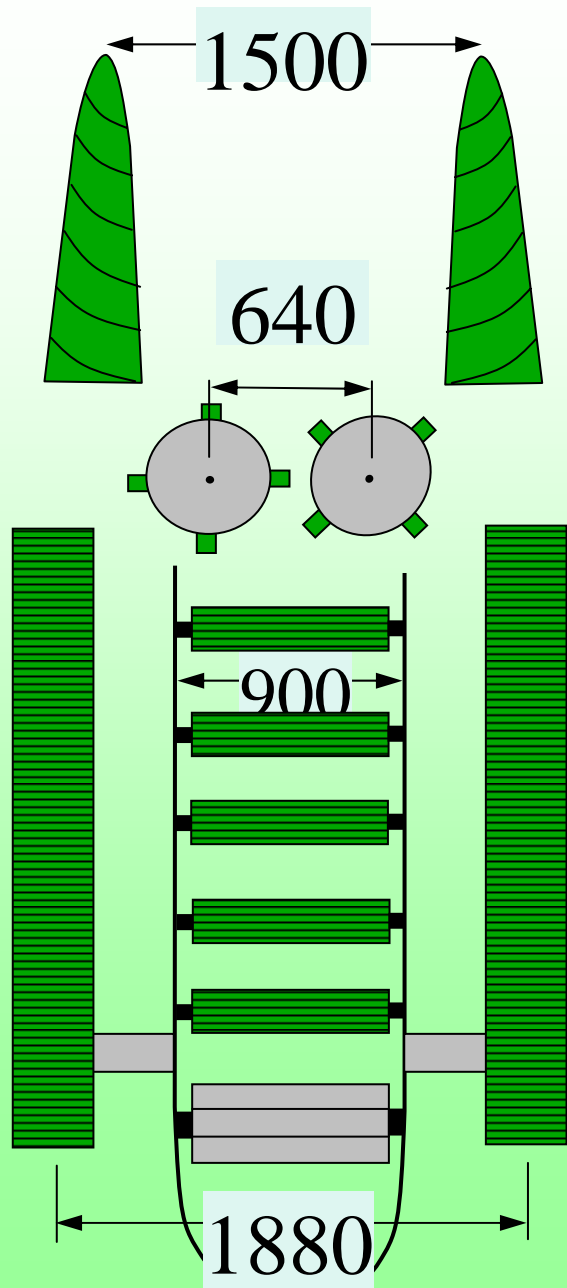
AUSSIE 5 Feet (1524mm) ROW SPACING
6 FEET (1850mm) WHEEL SPACING

COMPACTED SOIL > 70%



CURRENT CAMECO & CASE HARVESTERS

70



**THIS DESIGN CONCEPT
HAS REACHED THE LIMIT
OF ITS CAPABILITY**

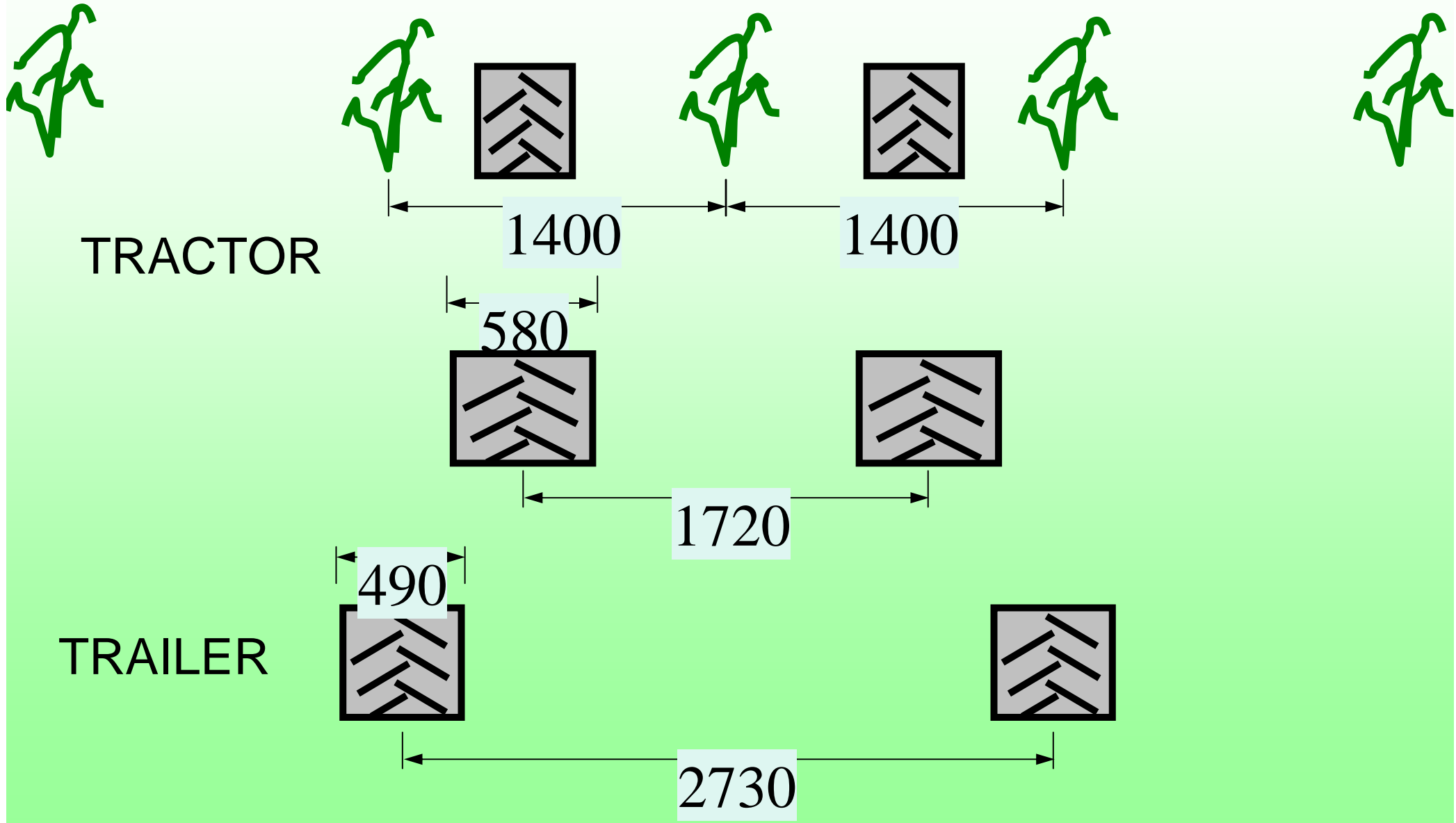
SPACERS REQUIRED TO ACHIEVE

2M WHEEL = 60mm each side

2.4M TRACK SPACE = 260mm each side

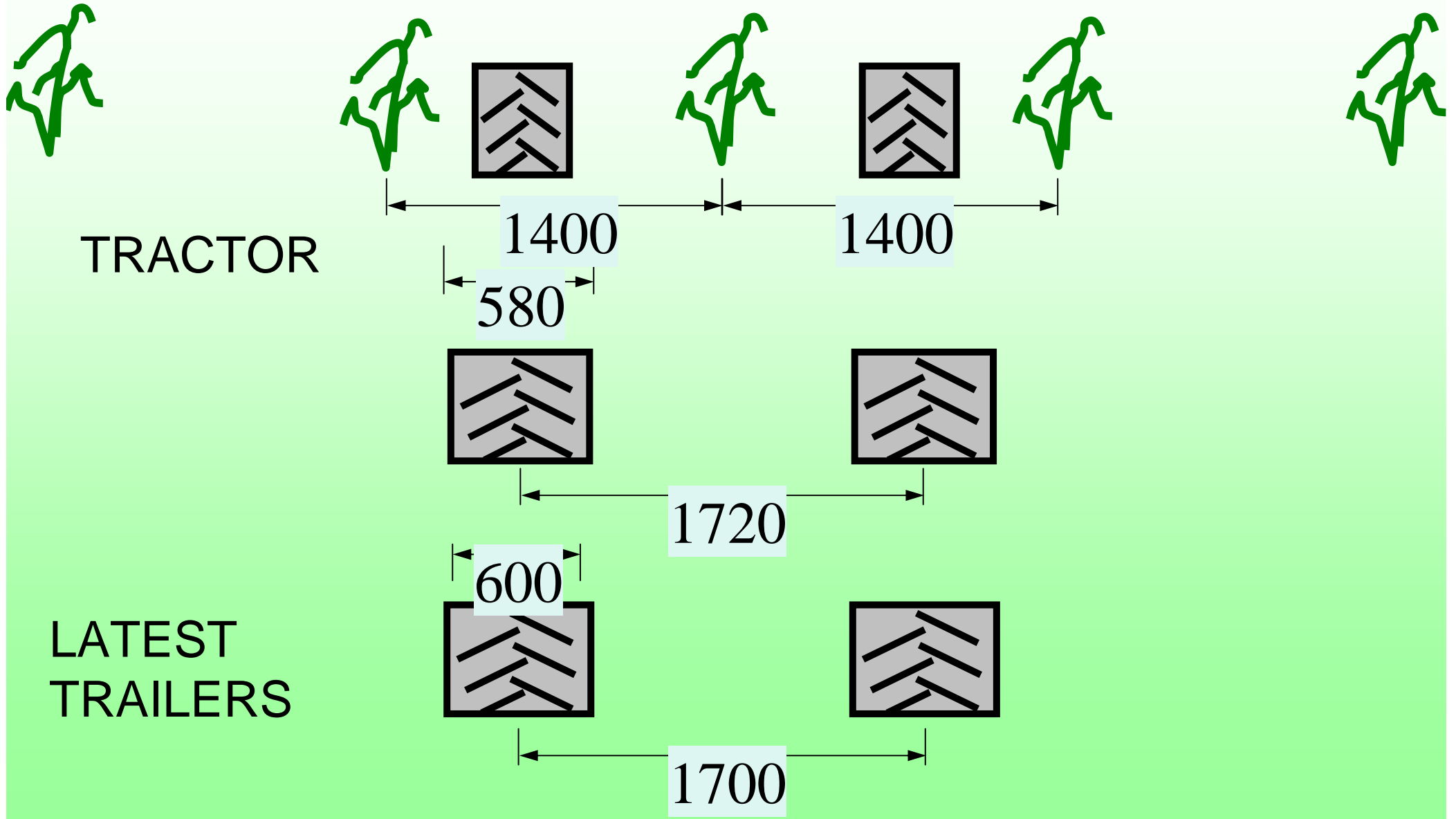
CURRENT BRAZIL INFIELD TRANSPORT SYSTEM

JUNE/04



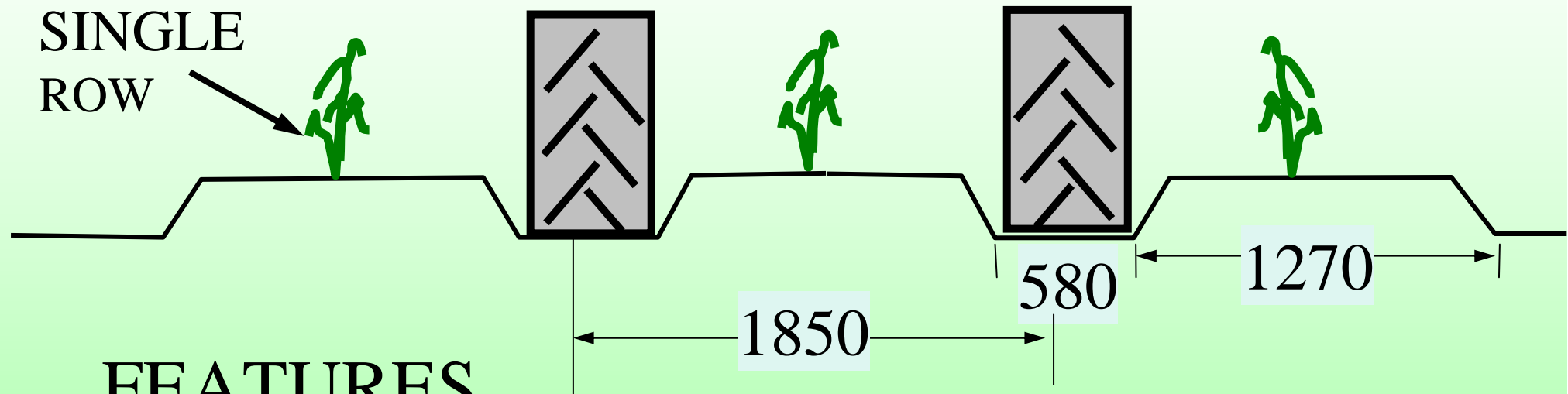
CURRENT BRAZIL INFIELD TRANSPORT SYSTEM

JUNE/04



1.850M ROW SPACING & WHEEL SPACING 73

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

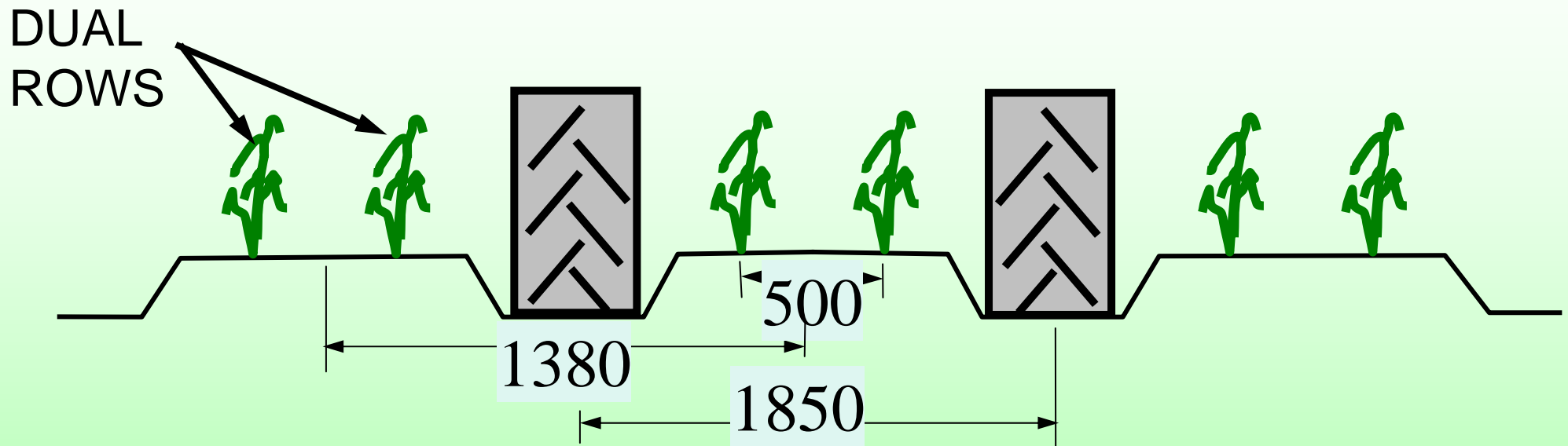
PROBLEMS:

- 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

75

COMPACTED SOIL = 35%



FEATURES

DUAL ROW RATIO = 2.76

- 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

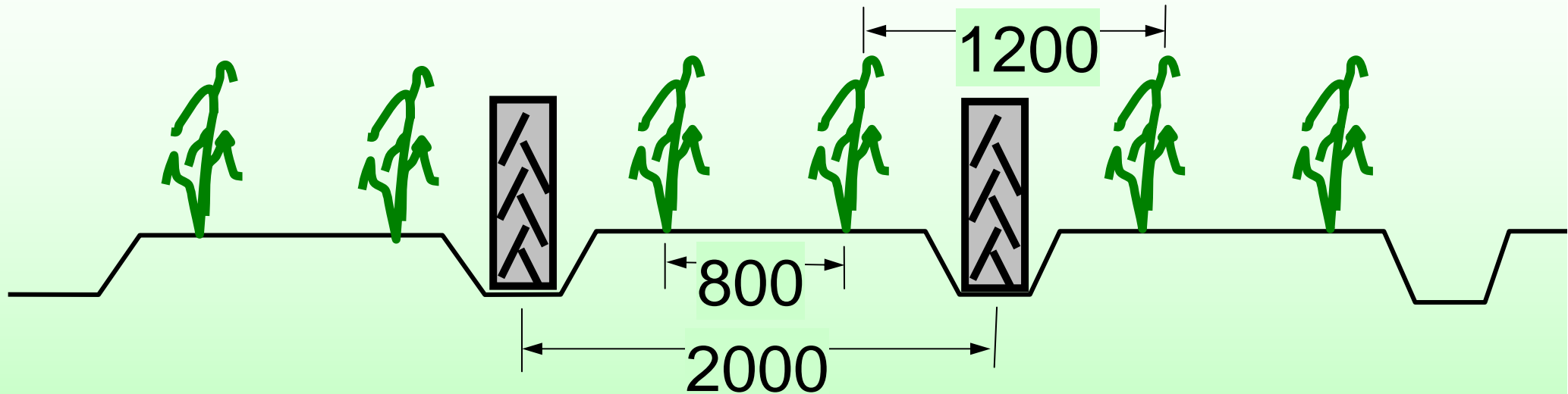
PROBLEMS:

- 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

77

COMPACTED SOIL = 32%



FEATURES

DUAL ROW RATIO = 1.5

- 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

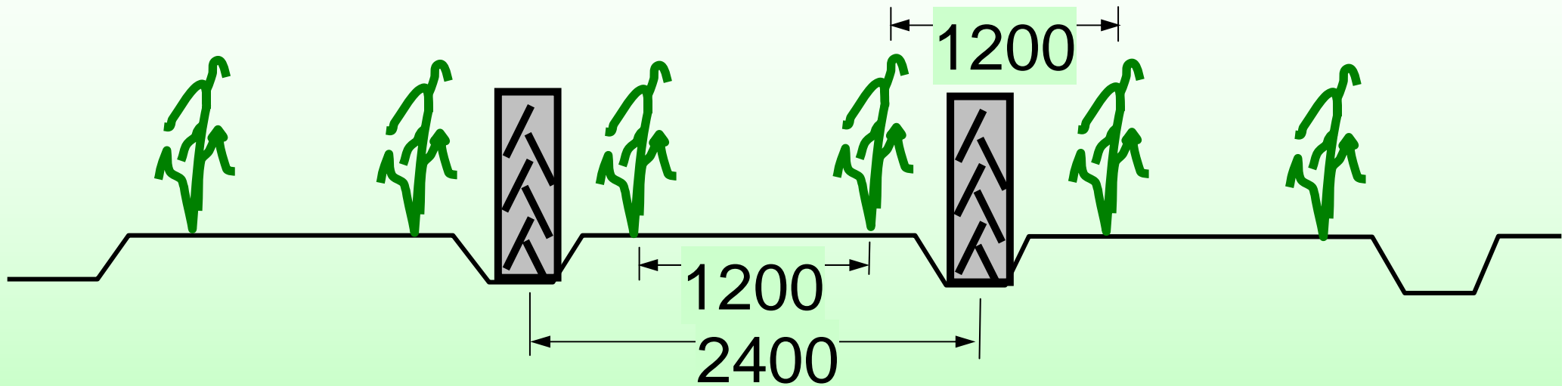
PROBLEMS:

- 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

79

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

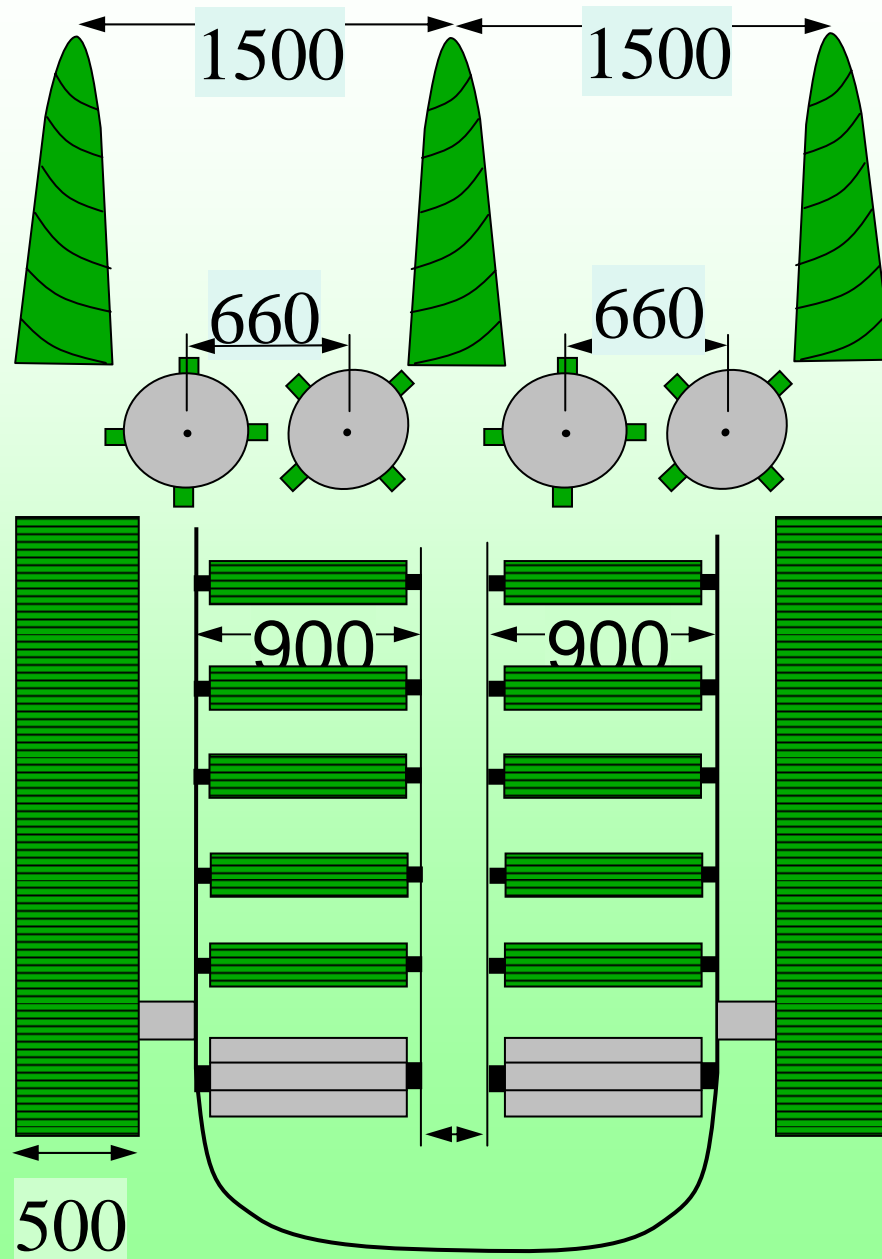
81

- 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

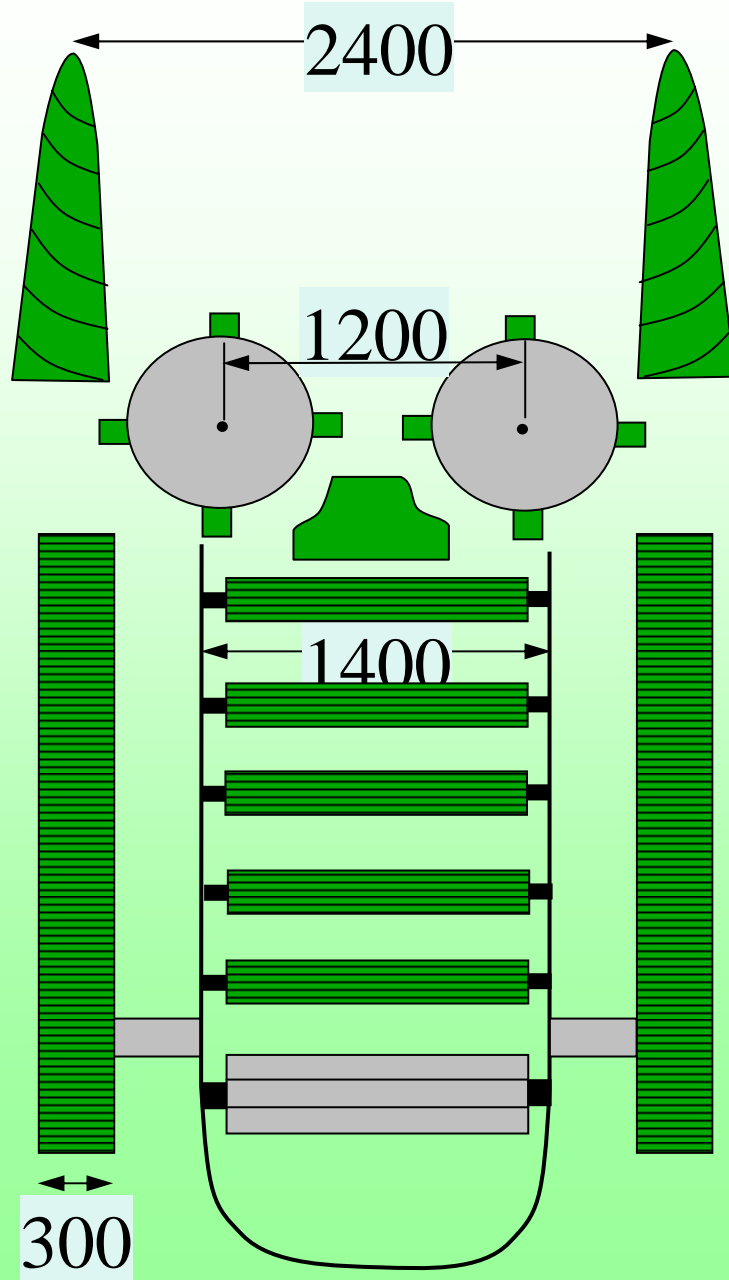


For ROW SPACING of 1.5M

**POTENTIAL
CAPACITY
INCREASE + 110%**

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

FUTURE DESIGN CONCEPT

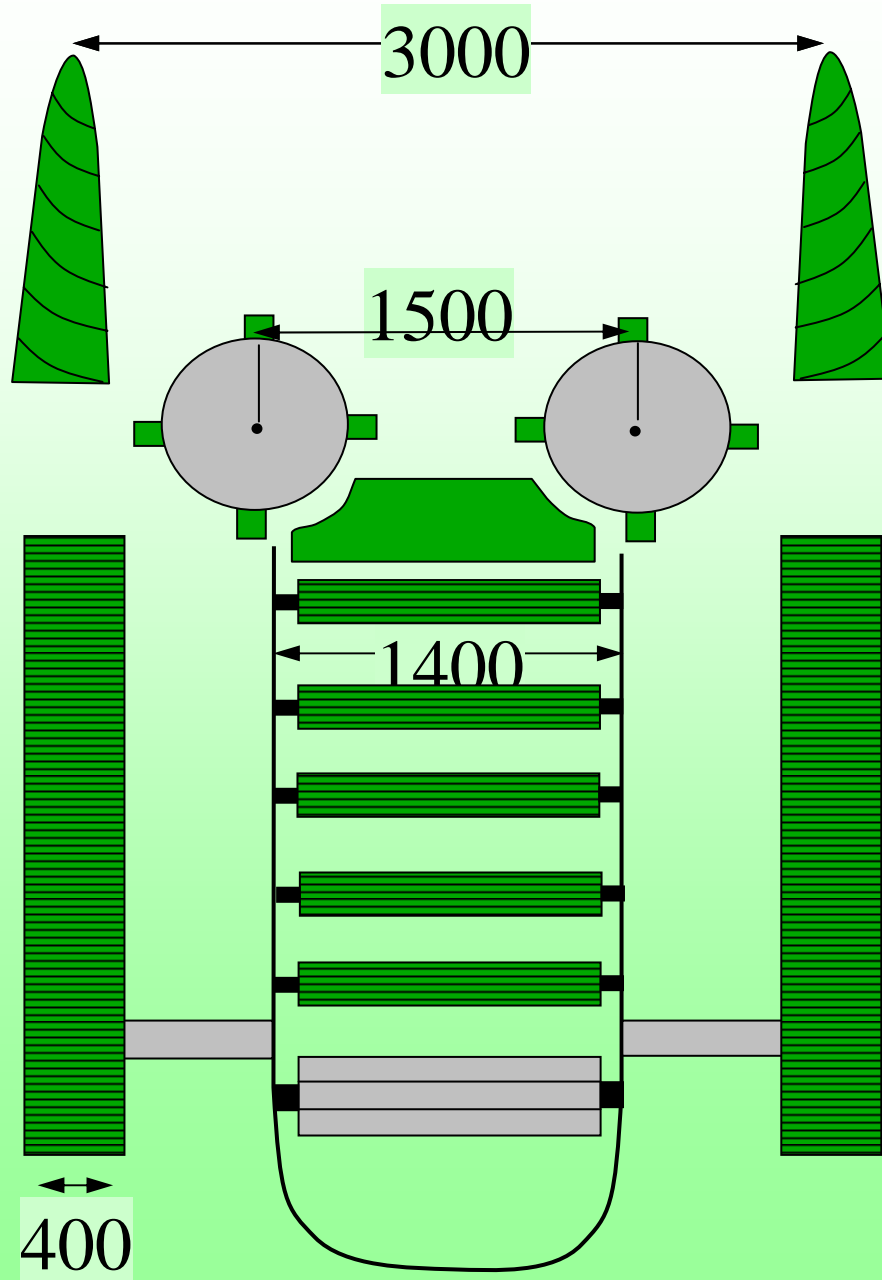


**2.4M WHEEL (or TRACK)
SPACING**

**POTENTIAL CAPACITY
INCREASE + 60%**



FUTURE DESIGN CONCEPT



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

POTENTIAL CAPACITY
INCREASE + 110%

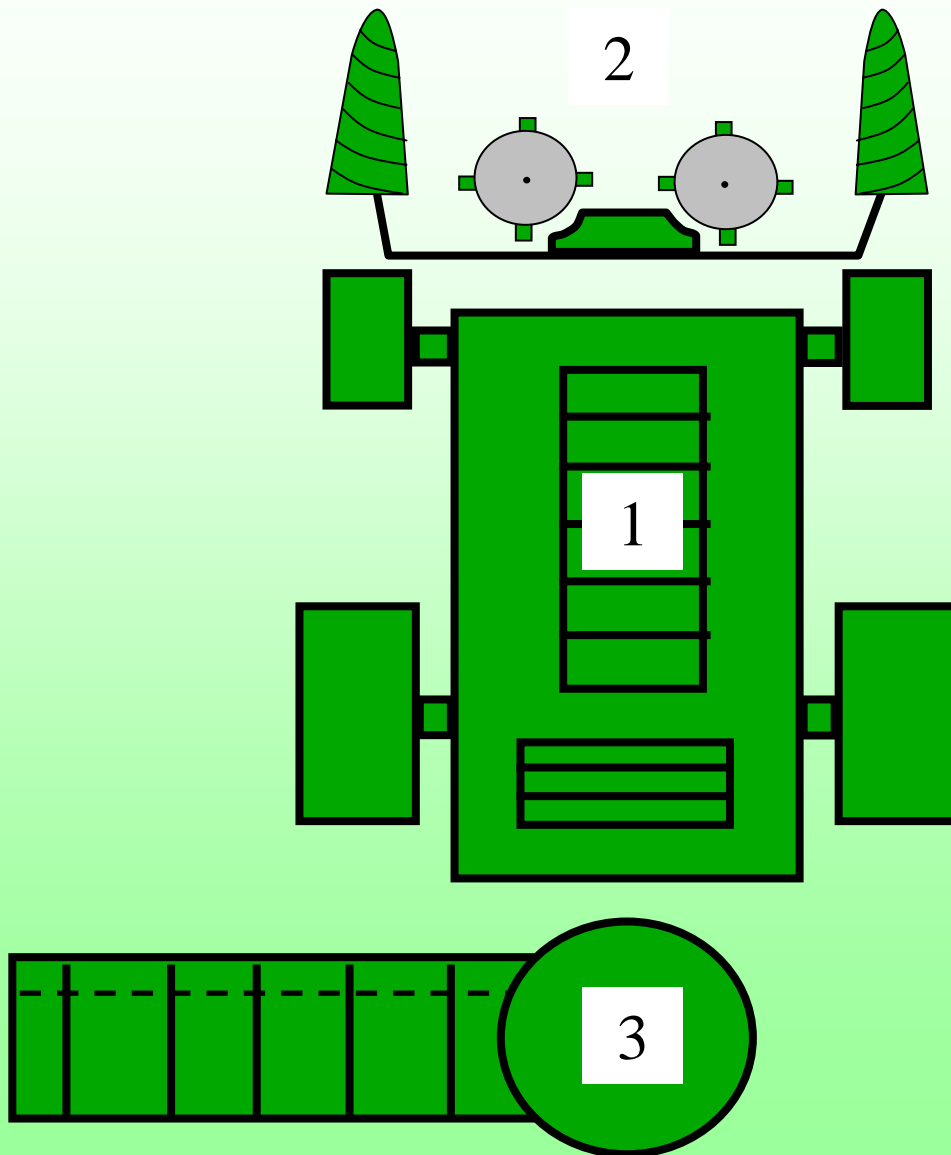


MODULAR HARVESTER CONCEPT

85

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

