

The role of spineless cactus pear (*Opuntia ficus-indica*) in animal nutrition

CR Swart Auditorium, University of the Free State
Bloemfontein – 12 February 2014

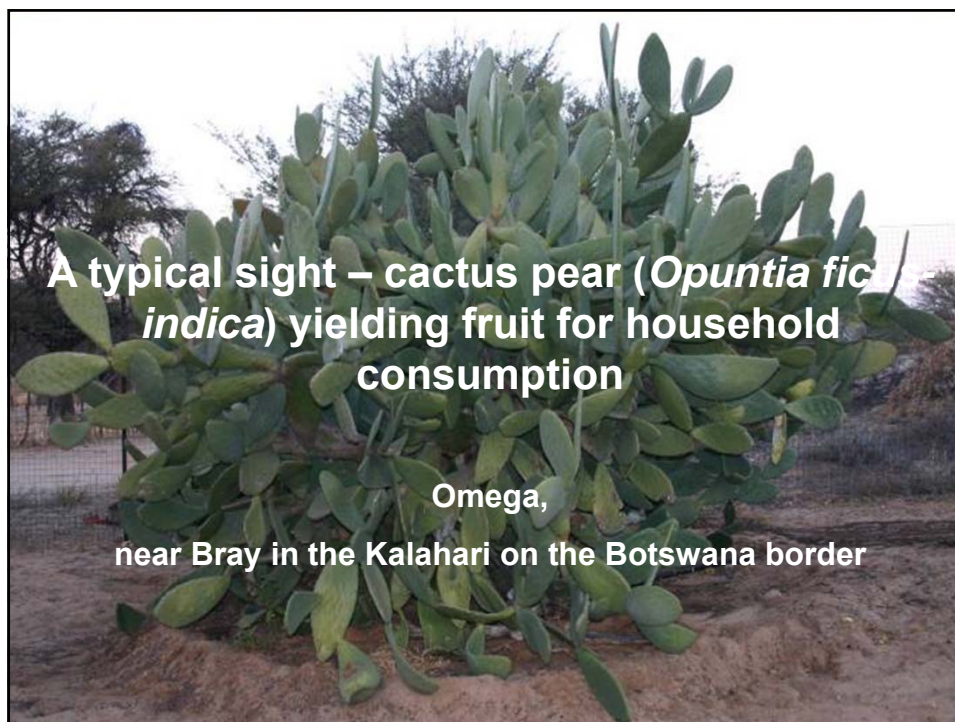


HO de Waal & Willie Combrinck
Department of Animal, Wildlife and Grassland Sciences
Faculty of Natural and Agricultural Sciences
University of the Free State, PO Box 339, Bloemfontein, South Africa

A common view in many parts of the country

Cactus pears were promoted as fodder bank
for livestock during recurring droughts in
South Africa





Cactus pear (*Opuntia ficus-indica*)
Very efficient use of water
Photosynthesis -> Renewable DM production
- Carbon sequestration
High DM yields / ha

Fruit - 15 000 kg fresh fruit / ha

Cladodes - 60 000 kg fresh cladodes / ha
(Prune cladodes to improve fruit quality)



Cladodes - 400 000 kg ? fresh cladodes / ha
(Cladodes harvested as animal feed)

Fresh cladodes contain about 900 g water/kg

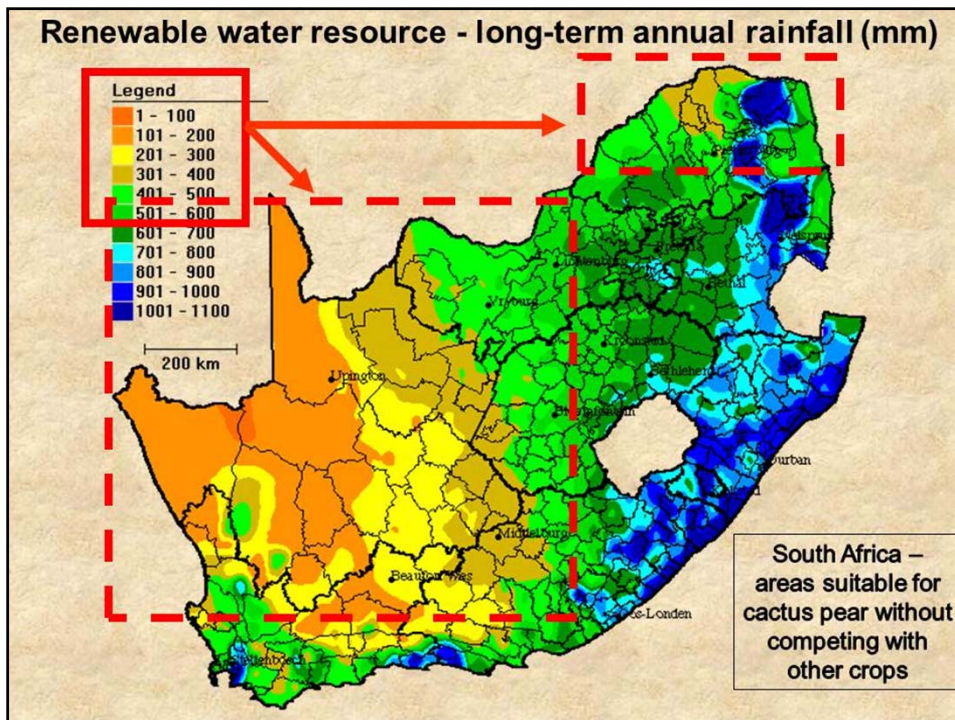
Water use efficiency (WUE)

Cactus pear is:

- 1.14 x** more efficient than **Old man saltbush** (*Atriplex nummularia*)
- 2.8 x** more efficient than **wheat** (*Triticum vulgare*)
- 3.75 x** more efficient than **lucerne** (*Medicago sativa*)
- 7.5 x** more efficient than **rangeland vegetation**

(De Kock, 1980; Azócar, 2001)



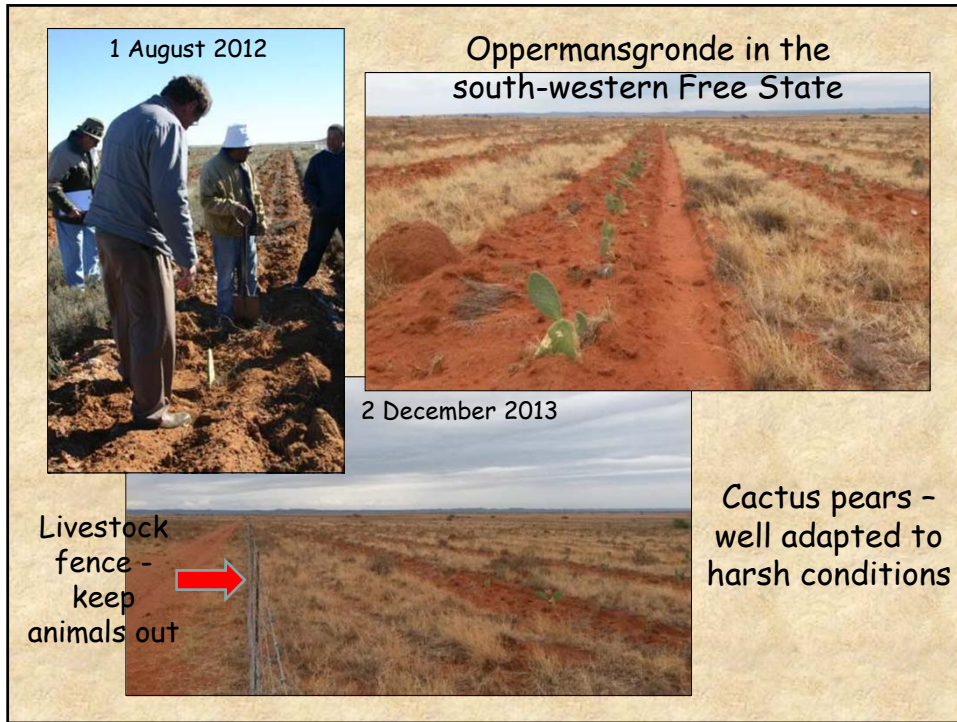
1 August 2012

Oppermansgronde in the south-western Free State

2 December 2013

Livestock fence - keep animals out

Cactus pears - well adapted to harsh conditions

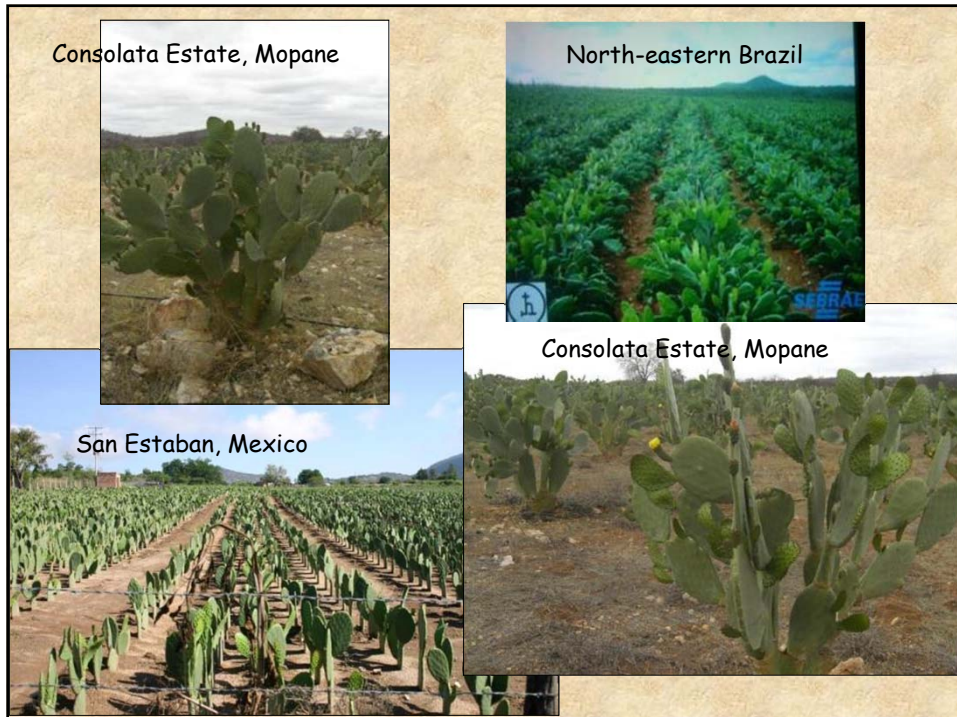


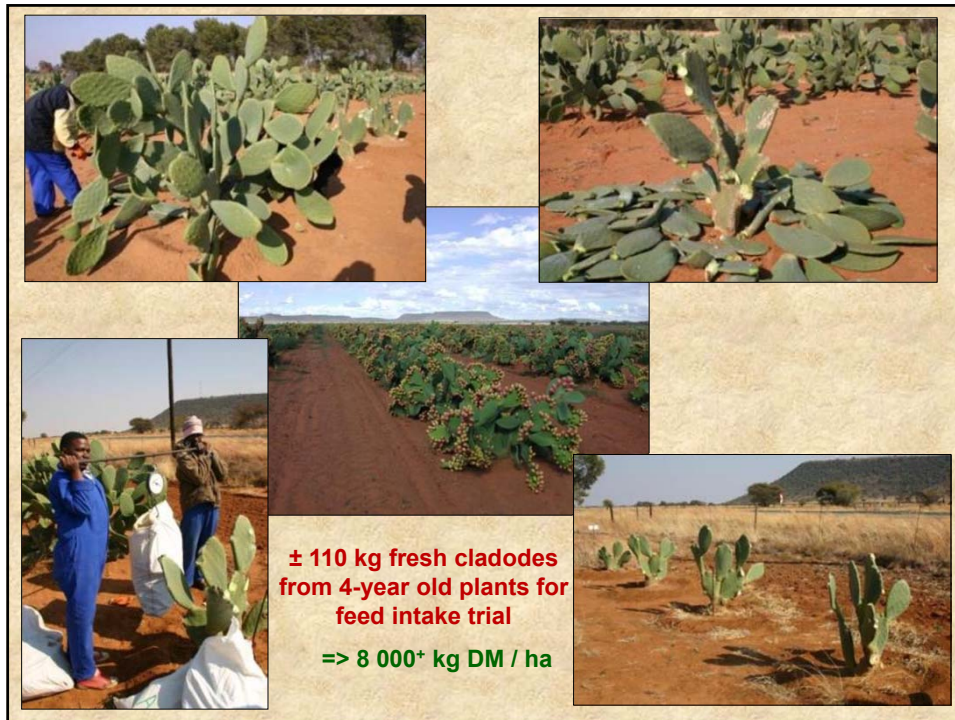
Consolata Estate, Mopane

North-eastern Brazil

San Estaban, Mexico

Consolata Estate, Mopane





Animal consumption ...



Processing of cladodes and evaluation in balanced diets



Animal consumption

Sun-drying of cladode strips on an elevated platform (covered with shade net)

Sun-dried and coarsely ground cladodes

Processing of cladodes and evaluation in balanced diets

Diet containing 36% cactus pear sun-dried and coarsely ground cladodes

Feed intake and digestibility trials

Reduce water content of cladodes from $\pm 90\%$ to $< 13\%$

Process

Mix diets



Feed and water intake and urine and faeces excreted by sheep on diets with incremental inclusion levels of sun-dried cactus pear (*Opuntia ficus-indica* var. Algerian) cladodes

	Treatment diets			
	T0	T12	T24	T36
Feed intake (g DM/day)	1148	1119	1104	1086
Water intake (ml/day)	2236 ^b	2695 ^{a,b}	2949 ^{a,b}	3189 ^a
Urine excreted (ml/day)	779	812	845	950
Faeces excreted (g DM/day)	376	366	343	308
DM intake (g/kg W ^{0.75} /day)	78.4	75.1	73.8	73.9

^{a,b} Means in the same line with different superscripts differ significantly ($P < 0.05$)

Observations regarding the wet faeces

- ▶ The wet faeces is not foul smelling ...
- ▶ The **wetter faeces** is ascribed to the presence of **mucilage** ...
 - hydrophilic mucus-like compound that has a high water-holding capacity
 - precise function is not known, but generally believed that mucilage helps to retain water inside the cactus pear plant



Faeces
Diet T0



Faeces
Diet T36

... wet faeces was not as a result of induced diarrhoea, but larger quantities of water that was not absorbed from the faeces in the lower digestive tract



Typical feedlot appearance

Diet T0

Wet faeces in feedlot



Diet T36

Feed intake and digestibility - cactus pear-based diets



Inclusion of sun-dried and coarsely ground cactus pear (*Opuntia ficus-indica*) cladodes as partial substitution of lucerne in balanced sheep diets has no detrimental effect at a 36% inclusion level

No detrimental effects were observed in feed intake, apparent digestibility, and histological characteristics of the GIT mucosa of young Dorper wethers

How and where in the GIT of sheep is the absorption of water effected by the mucilage in cactus pear cladodes?



Histological results showed no visible pathologic alterations in the mucosa of the GIT of Dorper wethers when ingesting sun-dried and coarsely ground cladodes to a level of 36% in diets for a trial period of two weeks

Therefore, the reasons and mechanism whereby wet faeces are produced when sheep is fed diets containing considerable amounts of sun-dried and coarsely ground cladodes were not histological demonstrable

Composition of three treatment diets fed to Dorper wether lambs

(Katrina Lugambo Shiningavamwe, 2009)

Feed ingredient (kg air dry)	Treatment diets*		
	T0	T1	T2
Sun-dried and coarsely ground cladodes	-	330	300
Coarsely ground lucerne hay	577	255	190
Yellow maize meal	358	340	275
Feed grade urea	10	20	-
Sunflower oilcake meal	-	-	180
Molasses meal (Enermol)	40	40	40
Feed lime	15	15	15

* T0 - conventional feedlot diet; Cactus pear-based diets T1 & T2 – 330 and 300 g/kg sun-dried and coarsely ground cladodes, with different nitrogen sources (T1 – NPN and T2 – Natural protein)



Performance of the Dorper wether lambs during the feeding period in the feedlot and the cost of three treatment diets

(Katrina Lugambo Shiningavamwe, 2009)

Variable	Treatment diets *			P	CV ¹ %
	T0	T1	T2		
Initial live body weight (kg)	21.23±0.55 ^a	21.13±0.46 ^a	21.67±0.50 ^a	0.730	9.13
Final live body weight (kg)	35.46±0.11 ^a	32.43±0.53 ^a	35.60±0.64 ^a	0.057	11.0
Total weight gain (kg)	13.90±0.41 ^a	11.30±0.09 ^a	13.93±0.32 ^a	0.064	25.6
Average daily weight gain (ADG) (g)	180.6±3.7 ^a	125.4±0.8 ^b	181.0±2.9 ^a	<0.001	24.6
Feed intake (kg DM/day/head)	1.147±0.050 ^a	1.131±0.071 ^a	1.209±0.022 ^a	0.538	7.3
FCR (kg DM intake/kg gain)	6.07±0.73 ^b	8.25±0.27 ^a	6.11±0.16 ^b	0.036	10.9
Cost of diet/kg (N\$)	3.14±0.01 ^a	2.42±0.02 ^b	2.70±0.01 ^b	0.001	0.9
Cost of diet/head/day (N\$)	3.71±0.18 ^a	2.73±0.19 ^b	3.26±0.01 ^b	0.007	5.7

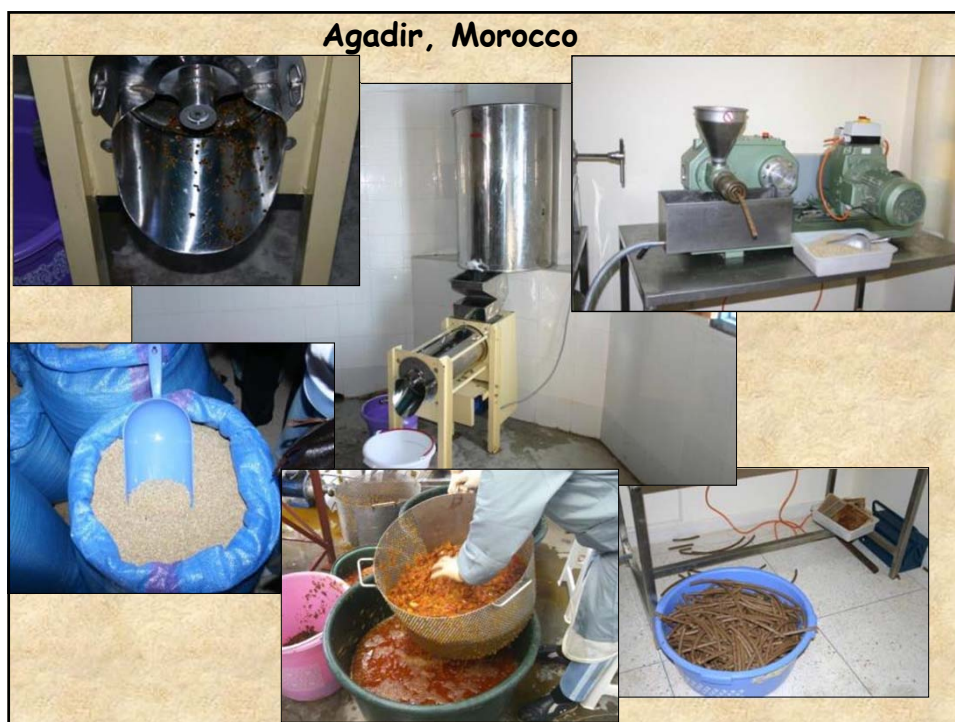
*T0 - conventional feedlot diet; Cactus pear-based diets T1 & T2 – 330 and 300 g/kg sun-dried and coarsely ground Cactus pear cladodes, with different nitrogen sources (T1 – NPN and T2 – Natural protein)

a,b Means with different superscripts within a row are significantly different (P < 0.05)

¹ Coefficient of variance

YOUNG LAMBS – USE NATURAL PROTEIN SOURCE – SUNFLOWER OIL CAKE MEAL





Preserving mashed cactus pear (*Opuntia ficus-indica*) fruit on straw and hay as **kuilmoes**

Mashed fruit - undiluted (Um) or diluted (Dm) with water to facilitate separation of the seeds for oil extrusion

Roughage	Mashed cactus pear fruit	
	Undiluted (Um)	Diluted (Dm)
Wheat straw (WS)	1 kg WS + 5 kg Mash	1 kg WS + 5 kg Mash
Maize hay (MH)	1 kg MH + 5 kg Mash	1 kg MH + 5 kg Mash
Lucerne hay (LH)	1 kg LH + 5 kg Mash	1 kg LH + 5 kg Mash





Composition of straw and hays, mashed cactus pear (*Opuntia ficus-indica*) fruit and different kuilmoes types

Treatment	DM	OM	CP	NDF	ADF	Fat	pH
	g/kg DM						
Wheat straw (WS)		902.4	45.9	744.9	479.6	7.67	
Maize hay (MH)		965.4	47.1	796.4	478.1	8.87	
Lucerne hay (LH)		916.8	169.4	462.9	406.5	9.18	
Mashed undiluted fruit (Um)		886.5	44.2	281.4	82.7	5.00	
Mash diluted fruit (Dm)		907.4	55.6	280.5	76.6	4.42	
WS + Um	301.2	897.3	80.1	557.3	405.5	16.00	3.62
WS + Dm	210.5	899.6	74.9	721.4	513.7	2.79	3.98
MH + Um	284.2	929.5	72.2	624.3	421.1	22.64	3.72
MH + Dm	160.5	942.3	55.4	781.1	470.7	3.83	3.95
LH + Um	307.0	909.0	136.4	415.5	377.5	18.95	3.82
LH + Dm	204.0	894.3	160.2	491.5	431.7	14.97	3.89

Kuilmoes

► Anaerobic fermentation by microbes rapidly decreased the pH of mashed cactus pear fruit and effectively preserved the mash on straw and hay

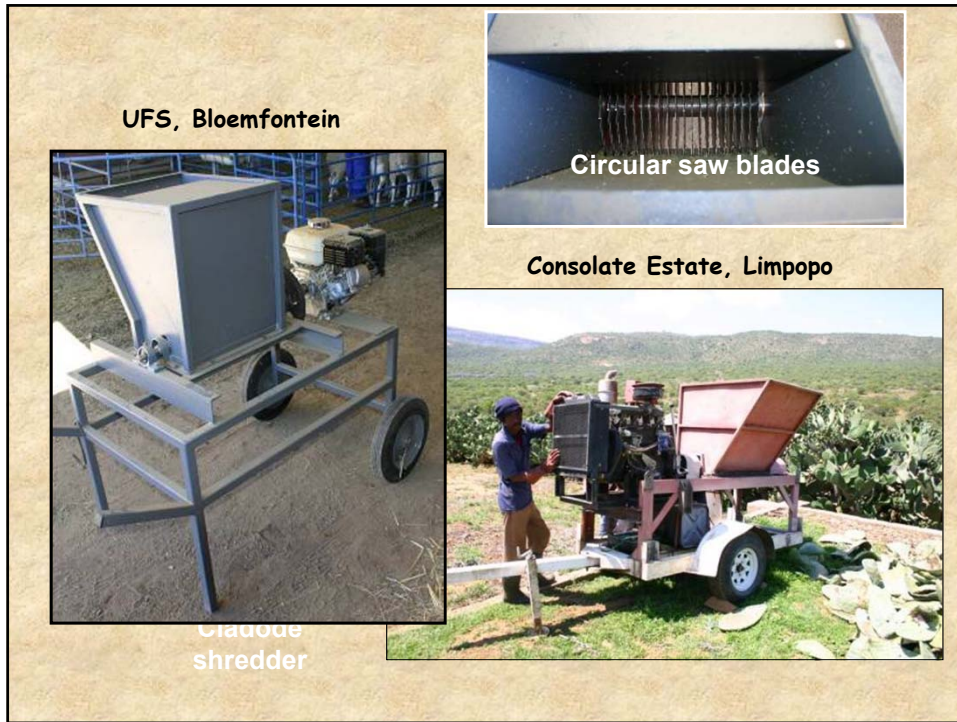


► Spineless cactus pear fruit is produced seasonally - mashed fruit can be preserved on dry straw and hay as kuilmoes



Evaluation of animal production







Dairy cows munching their ration of about 12 kg fresh cactus pear cladodes/cow/day as part of their daily diet in north-eastern Brazil





Role and application of cactus pear cladodes and fruit as animal feed

Ruminants – sheep, goats & cattle

Monogastric animals - pigs

Monogastric hindgut fermenters – ostriches & horses

Drying & processing cladodes → handling, transport, storage, etc.

... a multi-use crop ...

Thank you