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Inside this issue:

Utilising invasive cacti as processed livestock feed and as a means of control

The University of the Free State has developed a standard procedure for the processing of spiny cactus pears (*Opuntia* species) into livestock fodder which will ultimately assist in the management of massive infestations of spiny cactus and help to convert under-utilised farm land back to natural grazing land. See pages 2 to 4 for the details of this initiative.

Infestation of spiny *Opuntia engelmannii (*small round-leaved prickly pear*)*(centre), flanked on both sides by the spiny form of *O. ficus-indica* (sweet prickly pear) (Photo: HO de Waal)

Sterile cultivars: fact or fiction?

The regulations on Alien and Invasive species in the National Environmental Management: Biodiversity Act (NEM:BA) exempt the 'sterile cultivars or hybrids' of 30 plant species. So far no lists of these cultivars have been published.

Are all these cultivars actually sterile? There is an urgent need for studies of cultivars to determine their modes of reproduction and whether they are fertile, sterile or apomictic (asexual production of seed). Different types of sterility pose different levels of invasion risk.

Until scientific evidence proves the contrary we should assume that all cultivars are fertile. Read more on pages 5 and 6.

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Utilising invasive cacti as processed livestock feed and as a means of control

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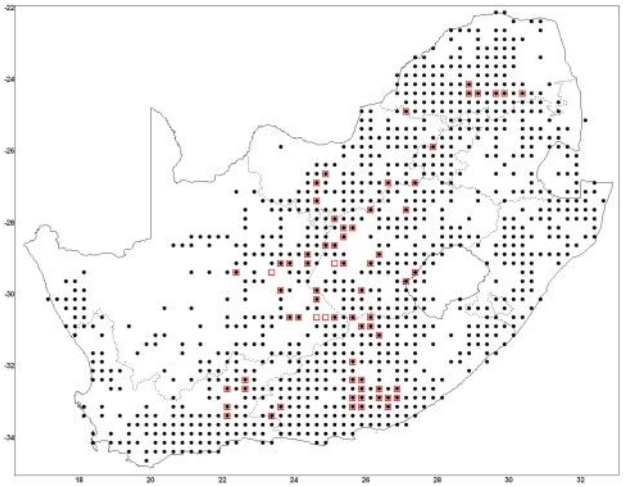
Why this initiative?

Scientists at the University of the Free State have made major advances in utilising spineless cactus pears (*Opuntia ficus-indica* and *O. robusta*) as multi-use crops for humans and livestock. In addition to the conventional uses of the fruits, cladodes and fruits have been processed as livestock feed (De Waal 2015).

Construction of a wind turbine farm was started by an Independent Power Producer (IPP) near Bedford in the Eastern Cape Province. However, the construction footprint was heavily invaded by spiny cactus pears, notably the spiny form of *O. ficus-indica* and the spiny *O. engelmannii*. Acting on good advice the IPP called on the local expertise and knowledge in dealing with cactus pears, albeit the spineless forms.



Map. The distributions of sweet prickly pear (*Opuntia ficus-indica*) (black dots) and small round-leaved prickly pear (*O. engelmannii*) (red squares). Source: SAPIA database, ARC-PPRI.

The origin and extent of spiny cactus pear invasions

Invasive alien plants (IAPs) pose a direct threat to South Africa's biological diversity, as well as to water security, the ecological functioning of natural systems and productive use of land. A range of methods are used to control IAP's, namely mechanical, chemical, biological and integrated control methods (Anonymous 2009). In this initiative the focus is on mechanical control.

The invading alien spiny cactus pears are well-known in South Africa (NEMBA 2014a,b). Indications are that they were introduced by seafarers to the Cape of Good Hope about 300 years ago and later transported to the interior of the subcontinent (Kiesling & Metzing 2017). Spiny cactus pears resulted in dense, impenetrable thickets in some regions, especially the Eastern Cape Province (see **map**). By the 1950's about 1 million ha of South Africa had been invaded by the alien cacti (Annecke & Moran 1978 cited by Moran *et al*. 2013). Infestations of the spiny form of *O. ficus -indica,* so-called sweet prickly pear, severely impacted on agriculture (Moran *et al*. 2013), despite it being utilised by people and livestock.

In the early 1900's spineless cactus pear cultivars (*O. ficus-indica* and *O. robusta*) were imported from the Burbank collection in California to the Grootfontein Agricultural College in the Eastern Cape Province (De Kock 2001; Mondragón-Jacobo & Peréz-González 2001). During the past few decades, fruit production by spineless cactus pear cultivars (*O. ficus-indica*) for local markets and export has gained momentum. The plants are pruned annually to stimulate production of quality fruit and most of the fresh cladodes are used as livestock feed (De Waal 2015).

South Africa has a long history of living with and combating invasive alien plant species, including alien spiny cactus pear species (Moran *et al.* 2013). Spiny cactus pears have invaded large parts of the Eastern Cape Province and the spiny form of *O. ficus-indica* and another spiny cactus pear species *O. engelmannii* are of particular interest in this initiative. Although biological control agents have been introduced (**photo 1**), the success in controlling the invading alien cactus pear species varies (Zimmermann 2009).

1

Biological control of *O. engelmannii* using cochineal insects (Photo: HO de Waal)

Utilising invasive cacti as a means of control

Harvesting and processing spiny cactus pears

In addition to the continued actions of two biological control agents, mechanical control is used to harvest alien spiny cactus pears and the large volume of material is processed as livestock feed. Infestations will be opened, reclaimed, rehabilitated and the natural pastures (veld) allowed to revert back to grazing for livestock.

The harvesting and processing of the spiny cactus pears is fairly simple, although it requires a good measure of physical strength, perseverance and the necessary protective clothing. There are three successive stages, namely:

- harvesting of plants (**photo 2**),

- shredding through a cladode cutter (**photo 3a**) and drying in the sun (**photo 3b**),

- grinding in a hammer mill (**photo 4**).

The long spines are degraded mechanically by grinding the sun-dried cladode strips in a hammer mill before including it in balanced livestock diets.

Recommendations and the way forward

Cactus pears propagate vegetatively by means of cladodes sprouting roots and sexually through seed production. Over many centuries the spiny cactus pear fruits have been eaten by avian and mammal species, including people (without appropriate toilet facilities to contain the seeds); hence a vast seedbed has been created, just waiting for the right conditions to germinate.

During the cactus pear fruit ripening period, ripe fruits with mature seeds must be separated before harvesting and processing the cladodes. Although cladodes sprout roots and propagate vegetatively, dispersion of spiny cactus pear seeds in the faeces of animals (**photo 5**) and humans is a major means of spreading these invaders.

Mechanical control of alien spiny cactus pears is viewed as a long-term management activity, spanning a period of at least 20 years or more (Zimmermann *et al*. 2004). A range of methods is used to control IAP's, including mechanical, chemical, biological and integrated control methods. A control programme must include the following three phases:

- Initial control to drastically reduce the existing population.

- Follow-up control of seedlings, root suckers and coppice growth.

- Maintenance control on an annual basis to sustain low alien plant numbers.

The logistical challenges of rough terrain and the distances from the cacti harvesting sites to a processing facility are impacting conventional norms for profitable business planning. The National Resource Management Programme (NRMP) will be approached for official support in clearing and rehabilitating massive areas of infestations by alien spiny cactus pears in the Eastern Cape Province. It is envisaged that such financial support may be provided similar to that for the Working for Water (WfW) Programme (Zimmermann et al. 2004; Anonymous 2009; Moran *et al*. 2013) and will be an investment in reducing the infestations by invaders and the rehabilitation and sustainable use of natural resources in South Africa.


2


3a


3b


4

Photos 1—4: Francois Havenga


5

Photo: 5 HO de Waal

Utilising invasive cacti as a means of control

The benefits

This initiative (starting in the Eastern Cape Province) is setting a baseline standard and creates an opportunity to manage the massive infestations of alien spiny cactus pears with mechanical control and to revert valuable under-utilised farm land back to natural grazing for livestock.

A primary objective of this baseline standard is to apply appropriate processing technology and transform the spiny plant material (through shredding, sun-drying and coarsely grinding in a hammer mill) into livestock feed which greatly limits the possibility of vegetative propagation.

An important spin-off and long-term benefit will also be gained from the large but untapped resource, namely converting invaders into useful processed livestock feed. Another important benefit is the range of employment opportunities which will be created for unemployed local people to engage in harvesting and processing the alien spiny cactus pears.

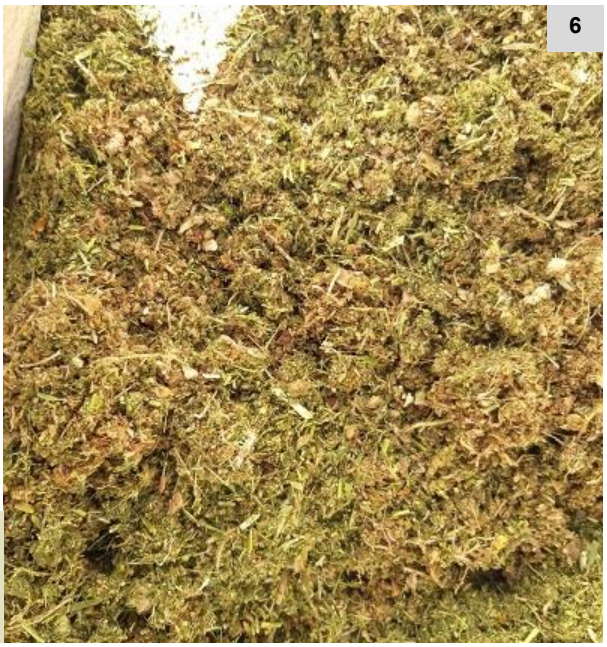


Photo 6: Shredded, sun-dried and coarsely ground spiny cactus pears (*Opuntia ficus-indica* and *O. engelmannii*), ready to be included in balanced diets for ruminant livestock (cattle, sheep, goats) and wild antelopes (photo: HO de Waal)

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Sterile cultivars: fact or fiction?

The great majority of invasive plant species listed in NEM:BA have been cultivated for their ornamental value and there are restrictions on their further cultivation. However, restrictions do not apply to the 'sterile cultivars or hybrids' of 30 species. To date, no lists or descriptions have been provided for these cultivars and to my knowledge (LH), no scientific evidence has been provided for their sterility.

Species for which 'sterile cultivars' have been exempted include the following invasive species: Mexican ageratum (*Ageratum houstonianum*) (**photo 1**), coreopsis (*Coreopsis lanceolata*) (**photo 2**), pampas grass (*Cortaderia selloana*) (**photo 3**), Chinese wax-leaved privet (*Ligustrum lucidum*) (**photo 4**), sword fern (*Nephrolepis cordifolia*) (**photo 5**), fountain grass (*Pennisetum setaceum*) (**photo 6**), and yellow firethorn (*Pyracantha angustifolia*) (**photo 7**).


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Studies of cultivars are needed to determine their modes of reproduction and whether they are fertile, sterile or apomictic (Gitonga *et al* 2013)

Female-sterile plants do not set seed and therefore cannot be invasive via seed dispersal. However, they produce viable pollen which can fertilize the flowers of compatible female-fertile plants. On the other hand, while **male-sterile** plants fail to produce functional anthers, pollen or male gametes, they can produce seed if they are pollinated by compatible male-fertile plants and therefore can be spread via seed dispersal.

Apomictic plants can reproduce asexually by producing seed without meiosis or fertilization. Fountain grass (**photo 7**) is an example of an apomictic plant.

Pennisetum setaceum 'Fireworks', a new cultivar selected as a culm sport (stem mutation) of *P. setaceum* 'Rubrum', the purple fountain grass (US PP18 504 P2, 2008) is a popular ornamental grass in the United States and Australia and has now been introduced into South Africa. It is said to be propagated asexually by culm division and tissue culture and 'rarely' sets seeds (US PP18 504 P2, 2008), but it is not yet clear under which conditions it will set seed and what mode of reproduction is involved. This then raises the question that, if appropriate conditions became available, would this species become invasive through prolific seed production and dispersal?


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Sterile cultivars: What is the invasion risk?

Sterile but capable of vegetative spread

Some invasive species are sterile yet can spread prolifically from vegetative parts such as rhizomes, stem fragments, root suckering, rooting of stems and sterile fruits (as in cacti) (**photo 8**: boxing glove cactus, *Cylindropuntia fulgida* var. *mamillata*). The blue periwinkle (*Vinca major*) (**photo 9**) spreads vigorously by stem rooting.

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Different risks of invasion (Gitonga *et al* 2013)

Plant species possessing both female and male fertility are likely to pose the greatest threat of becoming highly invasive. This category may include apomictic species, because they produce large amounts of viable asexual seeds and also produce viable pollen. Those possessing only female fertility may pose a threat of becoming highly invasive depending on seed fecundity and dispersal mechanisms, while the plant species with female sterility and male fertility may pose a threat of becoming invasive in the presence of compatible mates with alien and native plants. **Minimal threat should be posed by plant species with both female and male sterility depending on what vegetative propagation method they use.**

The creeping, yellow *Lantana* cultivar 'Sundancer' (**photo 10**) is only sterile if planted in isolation, and is inter-fertile with the invasive *Lantana camara.* While 'Sundancer' per se might not be invasive its ability to cross-pollinate the invasive *Lantana* has serious implications because by so-doing it adds its genes to the gene pool of the invasive *Lantana* complex, thereby increasing its genetic heterogeneity, hybrid vigour, resistance to biocontrol agents, invasiveness and suppression of indigenous biodiversity (Henderson 2009).

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Some facts about cultivars (Knight *et al* 2011)

Cultivars with reduced fertility are being marketed by some suppliers as less invasive, but scientific evidence for this claim is lacking (e.g. Japanese barberry, *Berberis thunbergii* 'Crimson Pygmy')

Reductions in seed production or seed viability alone are likely not sufficient to create a "safe" cultivar for an invasive long-lived perennial or woody plant.

Ornamental cultivars are seldom 'seed selections'; they are usually clones that do not breed true. Cultivars per se don't invade; their progeny invade and may not resemble the parent plants.

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ARC-PPRI, WEEDS RESEARCH DIVISION

The Weeds Research Division of the ARC-Plant Protection Research (PPR) is responsible for research on the ecology and control of invasive alien plants in South Africa.

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