

## **Congress 40 - Peter Edwards Award**

by John Clayton

The Peter Edwards Trophy is awarded at the annual GSSA Congress in recognition of outstanding contribution towards conservation farming in the province where the Congress is held. The recipients this year were Karel and Rika Landman who own and, together with their management team, run the Pongola Game Reserve on the northern section of the Pongolapoort Dam.

Their land use gradually changed from a beef enterprise in 1980, when they ran up to 2000 head of cattle on some 7150 ha, until 1992 when the last cattle were removed to concentrate on game. They run six camps - two catered lodges, four self catering camps (two of which are hunting camps), with a total capacity of 110 beds. The business has over 80 full time employees, 31 of whom are in managerial positions, with 58% of the management staff being black.

Approximately half of the 68 000 kg carcass weight removed annually is processed through their handling facilities to products required by their hunting clients. The enterprise brings in a gross of approximately R950/ha, which is well above the average return for beef ranching in the area.

Karel's commitment to the game industry in KZN was recognised by the Natal Game Ranchers Association when he became Honorary Life Member in 2000. The training facility which was established on the ranch in 2004 has to date enabled 89 students to complete a 14 day hunting guide course, as well as other courses that are run at this facility from time to time.

The Peter Edwards Award has found a very deserving home for the next 12 months.

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## **ENDOPHYTE IN PASTURES SYMPOSIUM**

**HELD AT GSSA CONGRESS 40:  
ENDOPHYTES, INSECTS  
AND PASTURES**

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by

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### **Reasons for a symposium discussing endophytes in pastures**

It is of utmost importance that the discussion and research on endophytes in pastures is given some attention in South Africa. This has long been part of the New Zealand and to some extent the Australian perennial ryegrass pasture scene. Some of this information is now spilling over to South Africa, especially the possible advantages of having such a fungal organism present in the pasture. However, there is very little information about the behaviour of endophytes, the real benefits under South African conditions and the possible disadvantages of endophytes for the South African pasture/dairy industry.

The purpose of the symposium was to start the discussion process and assess what knowledge base we have to date and what the critical research questions are. It is important that we understand the organism and its functioning under our climatic conditions before it becomes widespread throughout the industry. Perennial ryegrass seed with endophyte is already on sale in South Africa, although the extent is not known at present.

Various guest speakers were invited to give presentations at the symposium, which ended with a facilitated discussion. Professors Wijnand Swart and Schalk Louw from the University of the Free State, Andrew Beckerling of Profert, Jan Coetzer of Agricol

and Dave Goodenough of the ARC Livestock Business Division (Range and Forage) presented papers on specific aspects of this complex three-way interaction between the ryegrass plant, the endophytic fungi and the insects feeding on ryegrass and tall fescue. Problems related to animal disorders in endophyte-infected tall fescue and perennial ryegrass pastures were also highlighted.

### What are endophytes?

By definition endophytes are fungi that live internally in plants without the plant showing any symptoms. They are found in all plants and are abundant and very diverse. Endophytes in grass plants infect the above ground plant parts. They are mainly transmitted via hyphae in the grass seed. These fungi produce alkaloid poisons or mycotoxins. These are of benefit to the host plant by giving it a defense mechanism against both vertebrate and invertebrate herbivores i.e. against grazing animals and insects. Some examples of these mycotoxins are peramine, lolitrem B and ergovaline. Other reported benefits to the host plant can be disease resistance, decreased nematode predation, and increased plant vigour. Thus the competitive abilities of the host plant in stress conditions could be enhanced e.g. heat and drought stress.

The advantages to the fungus in this mutualistic relationship are a stable environment free from competing microorganisms, nutrients being provided by the grass plant and dissemination via the grass seeds. These fungi grow between the plant cells and do not cause any defense responses by the host plant.

There is however some evidence that the relationship between the endophyte and the grass also has costs to the host and is dependent on the plant environment and the genotype. The fungus could act as a nutrient sink. There are case studies that show plants without endophyte to produce better than

plants with endophyte. For example, stressed perennial ryegrass plants (low nutrient levels, drought or low light intensity) without endophyte, performed better than plants with endophyte.

### Endophytes in agronomic grasses

The endophytes found in grasses are of the genus *Neotyphodium*. The endophyte associated with perennial ryegrass is *N. lolii*, and in tall fescue *N. coenophialum*. For both these species there are the so-called wild/standard strains and the safe/novel strains. The wild/standard strains produce a host of mycotoxins, some of which result in animal health problems such as heat stress and blood circulation disturbances. The safe/novel strains have been selected specifically for producing only some of the mycotoxins which deter the invertebrates but have little or no effect on the grazing animal.

The mycotoxin ergovaline seems to be one of the main culprits in causing animal disorders. Cattle ingesting these toxins can have increased body temperature and hooves and tails falling off due to blood circulation problems. These symptoms result in lower feed intake, lower weight gains and lower milk production. It may also happen that these symptoms are sub-clinical while still resulting in loss of animal production. The alkaloid peramine is mainly responsible for deterring insects and thus present in the novel endophytes. Other alkaloids produced by the fungus are loline, a natural insecticide also present in novel endophytes, and lolitrem B, an insect toxin and thought to be responsible for ryegrass staggers. Novel endophyte strains for both perennial ryegrass and tall fescue have recently been identified and developed for commercial use.

Grass endophytes (*Neotyphodium*) reproduce mainly asexually through transmission via the grass seed but a sexual life cycle could possibly also exist. In the sexual life cycle spores are produced on the

surface of the plant and allowed to disperse. More clarity is required on the conditions which could lead to the sexual life cycle.

### Insects in pastures in South Africa

In South Africa there is no information available about insects feeding on pasture in terms of quantifying the damage they do. Likewise there is no data available on the resistance to insect damage by endophytes under South African conditions. At best information can be roughly extrapolated from Australia and New Zealand.

The following insects are found in pastures in Australian and New Zealand and some endophyte-induced insect resistance exists: (Table 1)

The pests identified so far in pastures in the Tsitsikamma by dairy advisors and farmers have been categorised into two groups, namely “outbreaks” that occur under certain climatic conditions and “resident pests” that are more permanently part of the pasture management system in the region. Spittle bugs (*Locris arithmetica*), black maize beetle (*Heteronychus arator*) and armyworm have been identified as “outbreaks”. Fleas, aphids, other sucking insects, caterpillars, grasshoppers, slugs and snails are the “resident pests”.

Pasture farmers in the Tsitsikamma have had problems with poor ryegrass seedling survival, which they have termed “Round-up Syndrome” believing that the herbicide had

**Table 1: Insect pests in pastures in the Tsitsikamma**

Common name	Scientific name	South African equivalent	Damage agent / symptom
Argentine stem weevil	<i>Listronotus bonariensis</i>	All species of Naupactini	Adults and larvae
Black maize beetle	<i>Heteronychus arator</i>	<i>H. arator</i> occurs	Adults & larvae (root-feeding grubs)
Black field cricket	<i>Teleogryllus commodus</i>	<i>Gryllus bimaculatus</i>	Nymphs and adults
Bluegrass billbug	<i>Sphenophorus parvulus</i>	Numerous species of Rhynchophorinae	Adults and especially larvae (stem-borers and ectophages)
Common armyworm	<i>Mythimna convecta</i>	<i>Spodoptera expemta</i> (armyworm) & <i>S. exigua</i> (lesser armyworm)	Larvae
Common cutworm	<i>Agrotis efusa</i>	<i>A. segetum</i> & <i>A. ipsilon</i>	Larvae cut young plants near ground level
Bluegrass sod webworm	<i>Parapediasia teterella</i>	<i>Culladia inconspicuellla</i> & <i>Oligochroa terrella</i>	Larvae clip grass blades close to surface
Pasture mealy bug	<i>Balanococcus poae</i>	Not evident, but probably any of the <i>Pseudococcus</i> species	All life stages - cause “browning-off” of pastures
Oat aphid	<i>Rhopalosiphum padi</i>	<i>R. padi</i> is a universal pasture pest	Leaves roll up and spiral; are vectors of viral diseases
Russian wheat aphid	<i>Diuraphis noxia</i>	<i>D. noxia</i> occurs	All life stages - streaking and purpling of affected leaves

something to do with it. However, the actual cause is possibly pests above and below ground. These problems need urgent attention. Dairy production in the Tsitsikamma region is from 60 000 cows worth R450 million annual turnover in milk sales. The most limiting factor to dairy production in the area is the quality of the pasture and to improve this it is vital to have successful establishment of ryegrass through oversowing.

Some of the critical questions in relation to endophytes in pastures and their potential role in controlling insect pests are whether there is a possibility of insect resistance to endophytes, how the varying concentrations of endophyte in different plant parts affect their protective role (endophyte concentrations are higher in stems than in leaves), how much energy does the host plant actually invest in the storage of alkaloids and is this a reliable process throughout the existence of the plant?

It is critical that more knowledge is acquired about insects in pastures in South Africa, on their feeding behaviour, on how much damage they cause and what functional groups are involved. It may be useful to look at a more integrated health management strategy, which includes biological control agents such as predators, parasitoids and Bt (*Bacillus thuringiensis*) and not only to rely on endophytes.

### **Endophytes (*Neotyphodium*) in stored seeds**

Endophytes survive in the stored seeds only under very specific conditions. The relative humidity must not exceed 50%, the seed moisture content must be less than 11% and the air temperature must be below 10°C. This has relevance and implications on two fronts. Firstly it could mean that the perennial ryegrass and tall fescue seed imported to South Africa, which may have been infected with the standard endophyte, may no longer have been infected by the time it was shipped

to South Africa. On the other hand, if seed is inoculated with the novel endophyte and farmers are paying a premium price for the seed, it could mean that the endophyte has died by the time the seed reaches South Africa, or died whilst in storage in the seed company warehouses, resulting in no benefit to the farmer.

The effect of transport and storage conditions on the survival of endophyte in the grass seed requires urgent attention if there is to be importation of grass seeds with novel endophytes and especially if such products are sold at a premium price.

### **Outcomes of the symposium**

- The pasture-endophyte-insect relationship is a complex system.
- Research into insect pests and their effect on pasture production in South Africa is required.
- Will the novel endophytes control the insect pests found in South African pastures?
- Research into the current presence of endophytes in South African pastures, including indigenous endophytes and their possible effects on animal health is needed.
- Research into novel endophytes under South African conditions and their effect on pasture production and animal production is required.
- The survival of endophytes in seed during transport and storage requires investigation.
- Could endophytes change the amount and composition of mycotoxins produced under variable agroecological and climatic conditions?
- Is there a possibility of sexual reproduction i.e. horizontal transmission via spores of endophytes such as *Neotyphodium*?
- A multidisciplinary approach to the pasture-insect-endophyte system is required.
- The present state of knowledge of

endophytes in South African pastures and their future success is very limited.

It was decided to establish a so-called Endophyte in Pastures Forum with a steering committee under the chair of Bryan Mappedoram of the ARC Livestock Business Division (Range and Forage Unit) to look at research priorities and to get as many role players as possible involved. Presently there are already farmers in South Africa who are sowing perennial ryegrass seed with endophytes. Questions such as whether they are the novel or standard strains, whether they are actually still present in the seed after transport from Australasia, whether they will ultimately control the insect pests in South African pastures and improve pasture production and whether they could result in reduced animal production compared to a no-endophyte pasture, need to be addressed urgently for the sake of the pasture dairy industry in South Africa.

#### **Invited speakers at the Symposium:**

Prof WJ Swart, Centre for Plant Health Management, Department of Plant Sciences: Plant Pathology, University of the Free State.  
*A Mycological and Ecological Perspective of Endophytic fungi in Agronomic Grasses.*

Prof SvdM Louw, Centre for Plant Health Management and Department of Zoology and Entomology, University of the Free State.  
*The Pasture Endophyte Herbivore System: role of insects in a complex multifaceted interaction.*

Mr J Coetzer, Agricol Seed (Pty) Ltd.  
*Ryegrass Endophyte The Past, the Present and the Possible Future in South Africa.*

Mr A Beckerling, Profert Eastern Cape.  
*Pests in the Tsitsikamma*

Mr DCW Goodenough & BD Mappedoram, ARC Livestock Business Division, Cedara Centre, Range and Forage Unit.  
*Endophytes in tall fescue: a review.*

## **Livestock development in communal rangelands: What can be done to improve the success of interventions?**

By

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### **Synthesis of a session held at the 40<sup>th</sup> GSSA Congress, Port Shepstone, July 2005.**

Over the last decade or so, there has been increasing focus among researchers, extension services, NGOs and government departments on livestock development and resource management in communal rangelands of South Africa. At the same time, a considerable amount of research in a variety of disciplines has been done in South African communal rangelands since the early 1990s. Studies in South African communal rangelands (e.g. Bembridge 1984, Mokgope 2000, Ainslie 2002 (ed.) and studies therein and Vetter 2003 in the Eastern Cape; Tapson 1990 and Letty *et al* 2002 in KwaZulu-Natal, Debeaudoin 2001, Hendricks 2004 and Hendricks *et al* 2005 in Namaqualand) have found a number of common features which, in the case of the studies by Mokgope (2000) and Letty *et al.* (2002), includes land reform projects. There is also a growing body of experience in development projects of various kinds, which has been less well documented.

Despite this gradual accumulation of data and a growing understanding of the ecological, economic and social aspects of communal rangelands, most development and resource management interventions are still based on commercial models of improving veld condition and animal productivity. The lack of success of many of these interventions and the low rate of adoption of new technologies and management practices by the communities suggests that there is a need to review our