



# FACT SHEET

DECEMBER 2018

## ENDOPHYTE UPDATE

This fact sheet outlines best-practice for selecting and managing ryegrasses with novel endophyte (less toxic to stock) so they flourish and persist.

### ENDOPHYTES – THE FACTS

- Endophytes are naturally occurring fungi which live within grasses.
- While they help protect plants from insect damage, naturally-occurring endophytes can impact negatively on livestock performance.
- Specifically-selected novel endophytes will protect the plant while having minimal impact on animal health.
- Choose the novel endophyte that best meets the needs of your environment, farm system and pest profile.

### WHAT ARE ENDOPHYTES

Endophyte is a naturally occurring fungus. Its complete life-cycle occurs within grasses such as perennial ryegrass and tall fescue. It produces chemical compounds known as alkaloids, which confer some pasture pest control, but which may also cause production-limiting animal health problems.

Most New Zealand ryegrass pastures are infected with endophyte. The endophyte fungus grows between the cells of the host plant, drawing nutrients from it but in return conferring resistance to insect pests, drought tolerance, and protection from overgrazing. Such a beneficial relationship is known as a mutualistic symbiosis.

World-leading New Zealand research has discovered new or novel endophytes. Naturally occurring, these are available with a range of alkaloid profiles which will have varying effects on pests and livestock. This means farmers can select an endophyte that will protect the plant from specific insect pests while having little or no impact on animal health or productivity.

#### Standard endophytes

Up until 2000, the majority of ryegrass seed sold in New Zealand contained “standard” or wild endophyte. Thought to have come in seed from the UK, standard endophyte produced high levels of the toxins lolitrem B and ergovaline which can cause ryegrass staggers and severely affect stock performance in summer and autumn. Another alkaloid, peramine, deters feeding and egg laying in Argentine stem weevil but has no known effects on animal health.

#### Novel endophytes

Novel endophytes are selected endophyte strains that have known and understood alkaloid chemical compound profiles. Typically, they have little or none of the animal-production limiting toxins lolitrem B and ergovaline. They live inside grasses and help protect them against attack by pests such as Argentine stem weevil, pasture mealy bug and black beetle. While novel endophytes help protect the plant, they have limited – or no – impact on animal health or production.

### CHOOSING THE RIGHT ENDOPHYTE

Choice of endophyte should be based on whether ryegrass performance is limited by pests, balanced against the health and performance of livestock. This will also depend on region, farm types, soil type, climate and management.

The novel endophytes available have many of the bio-protective characteristics of standard endophyte, but are non-toxic or much less toxic to livestock. There is no need to sow ryegrass with the old toxic, standard endophyte.

**AR1** is non-toxic to livestock, and will give ryegrass protection against Argentine stem weevil and pasture mealybug, but only limited protection from black beetle and no protection from other pasture pests.

**AR37** gives the best pest protection of all endophytes, affecting all the above pests except grass grub. It can cause severe ryegrass staggers but generally at a much lower incidence and severity than standard endophyte.

**NEA2** give an overall level of protection against pests intermediate to AR1 and AR37.

Another endophyte group from meadow fescue, of which **U2** is an example, produces the insect deterrent lolines which are non-toxic to livestock but known to provide deterrence to a wide range of insect pests. U2 is not available in ryegrass.

Pests are detrimental to pasture growth and longevity. For further information on pasture pests and their management in your region go to AgPest ([www.agpest.co.nz](http://www.agpest.co.nz)).

**Endophyte-free ryegrass** will avoid the harmful effects of standard endophyte on stock, but it can have poor persistence and production. Endophyte-free ryegrass is susceptible to attack by a number of pasture pests, including Argentine stem weevil, pasture mealybug, root aphid, black beetle, grass grub and porina.

All information on endophytes available in the market place is rigorously scrutinised/authorised by an Industry Endophyte Technical Committee which has representatives from independent researchers and the seed industry.

## POINTS TO REMEMBER

- Ryegrass cultivars containing standard toxic endophyte can limit animal production and profitability and increase management costs.
- Novel endophytes currently available are less toxic and can be as persistent as ryegrass with standard endophyte.
- Work continues on assessing the persistence of new ryegrass cultivar/endophyte combinations.

## ENDOPHYTE ACTIVITY IN SEED

Endophytes are a perishable product in the seed. Seed lots containing novel endophytes (AR1, NEA2, AR37) are required to have a novel endophyte infection rate of at least 70% at the time of sale. This means that for every 100 seeds in the lot, at least 70 must be infected with viable (live) novel endophyte. This 70% level of viable endophyte has been accepted as a standard by the pastoral industry.

The level of viable endophyte in a seed lot is determined by a 'squash test' or a 'viable test'. A 'squash test' determines whether endophyte is present or absent in each seed examined. However, it cannot determine whether that endophyte is alive (viable) or dead. Endophyte in seed less than six months old is (almost) always viable, so a 'squash test' can be used to determine the percentage of viable endophyte in a seed lot that is less than six months old. A 'viable test' (sometimes called a 'grow out test') determines whether viable endophyte is present in a seedling. A viable test is always performed on seed older than six months, as endophyte infection rates may have started to drop, and a 'squash test' may no longer provide an accurate result.

Ensure the endophyte is still viable by asking your seed agent for a certificate showing the results of the 'viable test' test. This test must have been done within the last six months and show that, when planted and sown, at least 70% of the resulting plants had viable endophyte.

**Seed storage:** In the past decade, the seed industry has invested in controlled temperature/humidity seed storage and just-in-time delivery systems. This ensures the seed is sent to stores with the best possible endophyte levels. On farm, care must be taken to store seed in dry, cool conditions and ideally sow within three weeks of purchase. **Seed carried over between seasons on-farm, is likely to lose its live endophyte.** Many pasture failures with novel endophytes can be tracked down to seed sown with low viable endophyte levels.

**Seed mix:** Never mix novel endophyte ryegrass cultivars with standard endophyte. These standard endophytes are toxic to livestock and will affect animal health.

**Mixing an endophyte-free ryegrass with a novel endophyte cultivar means your pasture will be vulnerable to pest attack.**

## ESTABLISHMENT OF NOVEL ENDOPHYTE RYEGRASS PASTURES

Aim to start with a clean paddock free of any growing perennial ryegrass and free of any existing ryegrass seed. This will generally mean elimination of ryegrass from the old pastures between November and sowing in autumn.

**Only sow novel endophyte ryegrass seed in the following situations:**

1. Following a winter/spring/summer forage crop such as a brassica (turnips, leafy turnip, kale, rape), oats, forage maize, sorghum, or nil endophyte ryegrass (i.e. annual or short-term hybrid only).
2. Following a summer fallow, with cultivation commencing prior to November, when reproductive development is occurring in ryegrass, and eliminating any re-growth ryegrass plants over summer.
3. Following an arable crop such as wheat, maize, barley, peas, etc, or after maize with subsequent winter fallow or crop.
4. Following a double spray with glyphosate (or similar herbicide), spraying in late November and again in February.
5. Following a closely grazed and managed pasture through summer that has prevented any seedhead production, in a high rainfall area where seed fall or dormant seed are not usually a problem. Then sprayed out with relatively high rates of glyphosate (or similar herbicide) and conventionally cultivated or direct-drilled.
6. Following a silage crop that has been cut before any viable seed has been produced, and then sprayed out using relatively high rates of glyphosate (or similar herbicide) and conventionally cultivated or direct-drilled.

7. As endophytes are not effective during the germination and establishment period (six weeks), seed treatment and- where appropriate- insecticide is strongly recommended.

**Notes:**

1. In summer dry regions (Canterbury, Otago, East Coast North Island), particularly where ryegrass exists in resident pasture, the paddock should ideally be out of ryegrass for two summers to ensure 'pure' novel endophyte ryegrass effects.
2. Do not feed out hay made from standard endophyte perennial ryegrass pastures in paddocks intended to be sown in novel endophyte ryegrass in the 12 months prior to establishment. Any seed in the hay will contain standard endophyte.
3. To prevent ryegrass seed being transferred in dung, livestock that have grazed standard endophyte ryegrass pastures with seed-heads should not be moved directly on to the paddock sown in novel endophyte ryegrass during the summer and autumn prior to sowing. The "with-hold period" should be three days.

## MANAGEMENT FOR ESTABLISHED PASTURES OF NOVEL ENDOPHYTE RYEGRASS

Aim to prevent seed of standard endophytes being transferred into novel endophyte ryegrass paddocks by:

1. Not feeding out hay made from standard endophyte ryegrass pasture in novel endophyte ryegrass paddocks.

2. Trying to prevent the movement of livestock from standard endophyte ryegrass pastures that have seed-head present, to novel endophyte ryegrass pastures, as animals can spread seed through dung. The "with-holding period" should be three days.
3. Minimising contamination from seed carried on farm machinery that enters novel endophyte ryegrass pastures.
4. Renovation of novel endophyte ryegrass pastures by under-sowing should only be done with novel endophyte ryegrass seed.

**Grazing:** Many novel endophyte ryegrasses are more palatable than standard endophyte ryegrass. Care has to be taken to avoid grazing too low and damaging the growing points and removing the plant's reserves needed for regrowth, which, in grass, are above the ground in the basal stem. The minimum post-grazing pasture residual height should be 1000kg DM/ha (2-3 cm) for summer. Avoid persistently taking the pasture down to very short levels (i.e. below 1000kg DM/ha), especially in times of stress (e.g. low soil moisture).

The following tables have been developed by the Industry Endophyte Technical Committee and approved for use by NZPBRA Executive (20 September 2018).

**Table 1: Endophyte insect control**

These ratings are indicative and may vary slightly between cultivars. If Argentine stem weevil or black beetle are present at sowing, an appropriate seed treatment is recommended, to improve insect resistance during establishment.

### ENDOPHYTE INSECT CONTROL RYEGRASS and FESTULOLIUM *Updated in August 2018*

	Argentine stem weevil	Pasture mealy bug	Black beetle	Root aphid	Porina	Grass grub	Field cricket
Diploid perennial ryegrass							
AR1	++++	++++	+	- <sup>2</sup>	-	-	Not tested
NEA2	+++	(++++)	+++	++	Not tested	-	Not tested
AR37	++++ <sup>1</sup>	++++	+++	++++	+++	+	Not tested
Standard endophyte	++++	++++	+++	++	+	-	Not tested
Without endophyte	-	-	-	-	-	-	Not tested
Tetraploid perennial ryegrass							
AR1	(+++)	(++++)	+	- <sup>2</sup>	-	-	Not tested
AR37	(+++) <sup>1</sup>	(++++)	+++	++++	(+++)	+	Not tested
WE	-	-	-	-	-	-	Not tested
Festulolium							
U2	++++	(++++)	++++ <sup>3</sup>	++++	(++)	+++	+++
Italian and short term (hybrid) ryegrass							
AR1	++	(++++)	+	- <sup>2</sup>	Not tested	-	Not tested
NEA2	Not tested	(++++)	+++	Not tested	Not tested	-	Not tested
AR37	+++ <sup>1</sup>	(++++)	+++	Not tested	Not tested	-	Not tested
WE	-	-	-	-	-	-	Not tested

## Key to Tables

### – No control

**+ Low level control:** Endophyte may provide a measureable effect, but is unlikely to give any practical control.

**++ Moderate control:** Endophyte may provide some practical protection, with a low to moderate reduction in insect population.

**+++ Good control:** Endophyte markedly reduces insect damage under low to moderate insect pressures. Damage may still occur when insect pressure is high.

**++++ Very good control:** Endophyte consistently reduces insect populations and keeps pasture damage to low levels, even under high insect pressure.

**( ) Provisional result:** Further results needed to support the rating. Testing is ongoing.

## Notes

- AR37 endophyte controls Argentine stem weevil larvae, but not adults. While larvae cause most damage to pastures, adults can damage emerging grass seedlings. In areas prone to Argentine stem weevil, it is recommended to use treated seed for all cultivars with novel endophyte.
- AR1 plants are more susceptible to root aphid than plants without endophyte.
- Also active against black beetle larvae.

## ENDOPHYTE ANIMAL SAFETY RYEGRASS and FESTULOLIUM *Updated in August 2018*

These ratings are indicative. Animal performance and health can vary under different management systems between seasons.

	Sheep and lambs		Dairy cows and beef cattle	
	Freedom from ryegrass staggers	Animal production	Freedom from ryegrass staggers	Animal production
AR1	++++	++++	++++	++++
NEA	++++	++++	++++	Not tested
NEA2	++++	++++	++++	Not tested
AR37	+++ <sup>2</sup>	++++ <sup>3</sup>	++++ <sup>5</sup>	++++ <sup>6</sup>
U2	++++	++++	++++	++++
Standard endophyte	+ <sup>1</sup>	++ <sup>1</sup>	++ <sup>4</sup>	+++ <sup>4</sup>
Without endophyte	++++	++++	++++	++++

## Key to Tables

**+ Moderate animal production and health:** This endophyte is known to regularly cause significant problems.

**++ Moderate animal production and health:** This endophyte is known to regularly cause significant problems.

**+++ Good animal production and health:** This endophyte can cause problems from time to time

**++++ Very good animal production and health**

**NB** – All trialling for ryegrass staggers occurs under simulated worst case scenario management, and does not represent normal farm practice.

## Notes on sheep and lambs

- Standard endophyte can cause severe ryegrass staggers, can significantly decrease lamb growth rates in summer and autumn, and significantly increase dags.
- Ryegrass containing AR37 endophyte can cause severe ryegrass staggers, but the frequency of ryegrass staggers is much lower than for ryegrass with Standard endophyte. One50 AR37, Asset AR37, and Ohau AR37 may give rise to higher instances of ryegrass staggers than other AR37 cultivars in some situations.
- Lambs grazing ryegrass containing AR37 endophyte can have reduced LWG during periods of severe staggers.

## Notes on dairy cows and beef cattle

- Standard endophyte can cause ryegrass staggers, and has been shown to depress milk solids (MS) production through summer and autumn.
- While ryegrass staggers has not been observed on cattle and dairy cows, it could occur on rare occasions.
- In dairy trials overall MS production from ryegrass containing AR37 endophyte is not significantly different from that with AR1. A small reduction in MS was observed over summer on ryegrass containing AR37. A contributing factor to this was the lower clover content in AR37 pastures.

## ACKNOWLEDGEMENTS

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