



# FACT SHEET

JANUARY 2021

## 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 old 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 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 their pasture 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 the old “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, root aphid 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.

**NEA, NEA2 and NEA4** are a group of endophytes intermediate to AR1 and AR37. They provide better animal health than AR37, with very low risk of them causing ryegrass staggers, but provide broader insect control than AR1.

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 is less persistent and productive. 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 by an Industry group called the 'Endophyte Technical Committee (ETC)' which has representatives from independent researchers and the seed industry. The ETC produce insect control and animal health ratings of the different endophytes each year, with the current ratings (at time of writing) in this Factsheet.

## 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, NEA, NEA2, NEA4, 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 'seed squash test' or a 'seedling viable test'. A 'seed 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 'seed squash test' can be used to determine the percentage of viable endophyte in a seed lot that is less than six months old. A 'seedling viable test' (sometimes called a 'grow out test') germinates seed, with the resultant seedlings tested for endophyte. Only viable (or live) endophyte grows into the seedling, so this test determines whether viable endophyte is present. A seedling 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 seed you buy has the right endophyte type and level by asking your seed agent for a certificate showing the results of the relevant test. This test must have been done within the last six months.

**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 retail 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), chicory, red clover, oats, forage maize, sorghum, or nil endophyte ryegrass (i.e. annual or short-term ryegrass 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 have limited 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).

## ACKNOWLEDGEMENTS

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**1. ENDOPHYTE INSECT CONTROL**  
**RYEGRASS, FESTULOLIUM & CONTINENTAL TALL FESCUE**  
Approved by NZPBRA Executive 22<sup>nd</sup> September 2020

Endophyte Brand	Argentine stem weevil	Pasture mealy bug	Black beetle	Root aphid	Porina	Grass grub	Field cricket
<b>Diploid perennial ryegrass</b>							
AR1	++++	++++	+	<sup>-2</sup>	-	-	Not tested
NEA2	+++	(++++)	+++	++	Not tested	-	Not tested
NEA4	+++	(++++)	+++	++	Not tested	Not tested	Not tested
AR37	++++ <sup>1</sup>	++++	+++	++++	+++	+	Not tested
Standard endophyte	++++	++++	+++	++	+	-	Not tested
Without endophyte	-	-	-	-	-	-	Not tested
<b>Tetraploid perennial ryegrass</b>							
AR1	(+++)	(++++)	+	<sup>-2</sup>	-	-	Not tested
AR37	(+++) <sup>1</sup>	(++++)	+++	++++	(+++)	+	Not tested
Without endophyte	-	-	-	-	-	-	Not tested
<b>Italian and short term (hybrid) ryegrass</b>							
AR1	++	(++++)	+	<sup>-2</sup>	Not tested	-	Not tested
NEA	Not tested	(++++)	+++	Not tested	Not tested	-	Not tested
AR37	+++ <sup>1</sup>	(++++)	+++	Not tested	Not tested	-	Not tested
Without endophyte	-	-	-	-	-	-	Not tested
<b>Festulolium</b>							
U2	++++	(++++)	++++ <sup>3</sup>	++++	(++)	+++	+++
<b>Continental tall fescue</b>							
MaxP (AR584)	Not tested	Not tested	+++	(++++)	Not tested	(++)	+++
Without endophyte	-	-	-	-	-	-	-

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

## 2. ENDOPHYTE ANIMAL SAFETY

### RYEGRASS, FESTULOLIUM & CONTINENTAL TALL FESCUE

**Approved by NZPBRA Executive 22<sup>nd</sup> September 2020**

The information in this table is based on animal safety trialling protocols designed to expose animals to simulated worst-case scenario management. This involves forcing them to graze deep into the base of pure perennial ryegrass pastures that have been allowed to grow for several weeks over late spring/summer (similar to a hay crop) where they will encounter the highest concentrations of harmful endophyte chemicals if these are present.

This management does not represent normal farm practice although similar situations may arise on farms in rare circumstances. Under normal farm grazing practices, the contribution of basal pasture material to total animal dry matter intake is relatively low and therefore the intake of harmful chemicals (if they are present) is diluted. Thus, the likelihood of adverse effects on animals is reduced, but the potential for problems to occur may still exist if the endophyte brand is rated < 4-star for 'freedom from staggers' and/or there are comments on animal performance which flag potential issues.

Comments on animal performance have been moderated based on information from other trials (in addition to the formal animal safety testing protocols), consideration of the 'normal' grazing management practices implemented on farm (see previous paragraph), and recognition that animal diets are very seldom pure ryegrass. Other dietary components such as clovers or non-ryegrass grass species, crops or supplements will dilute the intake of endophyte alkaloids.

Endophyte brand	Freedom from staggers		Effects on animal performance
	Sheep and lambs	Cattle and dairy cows	
AR1	++++	++++	High level of animal performance
AR37	+++	++++	Typically provides a high level of animal performance. Can cause ryegrass staggers in sheep and lambs in extreme circumstances. Lamb liveweight gain can be reduced during periods of severe staggers. While ryegrass staggers has not been observed in cattle and dairy cows, it could occur on rare occasions.
NEA	++++	++++	High level of animal performance
NEA2	++++	++++	Typically provides a high level of animal performance. Lamb liveweight gain could be reduced in extreme circumstances. While no effects have been observed in cattle and dairy cows, body temperature could be elevated on rare occasions.
NEA4	++++	++++	Typically provides a high level of animal performance. Lamb liveweight gain could be reduced in extreme circumstances. While no effects have been observed in cattle and dairy cows, body temperature could be elevated on rare occasions.
U2	++++	++++	High level of animal performance
MaxP (AR584)	++++	++++	High level of animal performance
Standard endophyte	+	++	Can cause ryegrass staggers in sheep and lambs, and significantly decrease lamb growth rates in summer and autumn, and significantly increase dags In dairy cows, it has been shown to depress milksolids production through summer and autumn.
Without endophyte	++++	++++	High level of animal performance

**Key to ryegrass staggers ratings:**

- + Likely to cause severe staggers in most years
- ++ Can cause severe staggers in some years
- +++ Can cause severe staggers occasionally
- ++++ Very unlikely to cause staggers