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# **NEA endophyte**

*32 years technology inside our seed  
= the ideal balance of animal health  
& insect control*

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# Introduction

Barenbrug sells the widest range of endophytes available (*NEA*, *NEA2*, *NEA4*, *AR1* and *AR37*), putting us in the position to understand how best to match each to the right farm system.

We started researching our own *NEA* endophytes back in 1989, when endophyte science was hardly known. Our first animal trial in 1999 showed highly promising results, with a staggers-free ryegrass, and the Barenbrug novel endophyte programme has never looked back.

This booklet details the depth and breadth of data behind *NEA* technology to date. We believe *NEA* endophytes provide a near ideal balance of great animal health (better than *AR37*) and strong insect control (better than *AR1*).

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*NEA4 demo paddock showing up in the dry North Waikato, January 2020.*



*Maxsyn NEA4 strip (C) showing its summer advantage in Taranaki, February 2019.*



*NEA2 (centre plot) vs AR1 either side, keeping browntop out after 6 years at Mt Possession, Canterbury*



*Under severe ASW attack in Hawkes Bay, a plot of hybrid ryegrass with NEA endophyte (L) stands out against plots beside and behind without endophyte.*

# Endophyte Summary

## **NEA**

Available in the tetraploid *Shogun* hybrid ryegrass. Gives excellent animal health and performance, and good black beetle control, and is ideal as a 1-3 year high performance pasture.

## **NEA2**

Suits farm systems NZ-wide, providing persistent pasture for dairy cows, sheep and beef cattle with excellent animal performance and health. Ryegrass with *NEA2* gives good control of black beetle, Argentine stem weevil (ASW) and pasture mealy bug (provisional rating). Available in *Trojan* and *Rohan*.

## **NEA4**

A newer endophyte release, also providing persistent pasture for farm systems throughout NZ. Very similar in animal health, performance and insect control to *NEA2*, but forms a better relationship with some cultivars through seed production and storage. Available in *Maxsyn*, *Viscount* and *Tyson*.

## **AR1**

Provides excellent animal performance and health. But overall, has less insect control, and should not be sown in the northern North Island on soils affected by black beetle. Provides very good control of ASW and pasture mealy bug. Staggers free and available in *Governor*.

## **AR37**

Provides a wide spectrum of insect control, but has some animal health issues. Gives very good control of ASW, pasture mealy bug and root aphid, good control of black beetle, and some porina control. Lamb LWG on *AR37* is generally good, but although may be reduced in periods of severe ryegrass staggers. *AR37* must not be used for horses or deer because of its animal health issues. Available in *Governor*.

## **Low endophyte (LE)**

An option for areas of very limited insect damage. But many farmers in regions including Southland achieve better results from sowing ryegrasses containing *NEA* endophytes or *AR1*. *LE* provides no insect control. Available in *Governor*, *Trojan*, *Tyson*, *Rohan*, and *Viscount*.

# NEA's = superior animal performance

*NEA*, *NEA2* and *NEA4* endophyte have all been proven to support excellent animal performance.

To date we have run 22 separate replicated animal trials, from 1999 to 2020, assessing ryegrass staggers and liveweight gain for the *NEA* range, versus *AR1* and *AR37*.

These animal trials are run as 'worst case scenarios', and are deliberately designed to reveal any endophyte issues that could occur in a rare set of circumstances e.g. badly managed pasture, no supplementation and drought-type conditions.

The trials are the opposite of what you should do if you want good animal performance! We grow pure ryegrass pastures to 4+ t DM/ha so they have plenty of stem and summer seedhead. Lambs are then weighed and allocated across the plots, where they are set stocked without supplements for up to 8 weeks.

For the first 4 weeks, they eat higher ME parts of the pasture (leaf) but as time passes they graze into the stem, which is higher in any endophyte alkaloids.

Lambs are weighed again at the end of the trial to assess growth. All work is done under strict animal ethics and welfare protocols.

The result is truly a worst-case scenario in terms of animal performance, but it does give the best test of whether any endophyte issues might be seen in extreme circumstances.

Across all the trials lambs grazing *NEA* endophytes have shown the same liveweight gain as *AR1*, which is known for its excellent animal performance.



*A line of lambs of similar size and genetics are sourced, and at the start of the trial each is checked, weighed, and carefully sorted into equal mobs for each plot.*

# NEA's = little chance of ever seeing staggers

Dairy cows and beef – NEA, NEA2 and NEA4 provide ryegrass staggers free pasture.

Sheep and deer – Ryegrass staggers grazing NEA2 or NEA4 is a very low risk. In an extreme situation (i.e. summer drought where animals are forced to graze close to the ground) a low level of staggers might be seen in some animals.

Our 'worst case scenario' animal trials are designed to cause ryegrass staggers (RGS), with pure ryegrass pasture (no clovers), grown to a very high herbage mass over summer then set-stocked for 8 weeks, or until staggers on lambs grazing *Standard* endophyte control become too serious and lambs must be removed.

As the trials progress lambs are exposed to more stems and seedheads, with lower ME and higher endophyte alkaloid levels.

RGS is scored every week by moving lambs around the plot for a set period and individually assessing them for symptoms. Animals are scored with the Keogh Scale, on a 0-5 basis, where 0 represents no symptoms, and 5 very severe ryegrass staggers. Events with an average score  $\geq 3$  are significant staggers events.

Several examples are given in this section.



*A plot in the 2019 Courtenay grazing trial testing NEA4, at week 4 in February. In the Standard endophyte plots the RGS were so severe the trial was finished early due to animal ethics considerations. Throughout the trial no RGS was seen in lambs grazing NEA4 plots.*



*Looking across plots in the 2013 Ashley Dene grazing trial testing NEA2, at week 3 in March. In the Standard endophyte plots severe RGS was seen, with lambs averaging 35g LWG/day over the 8 week trial. Lambs grazing NEA2 averaged 130g LWG/day with the slightest amount of staggers.*

# NEA's = good black beetle control

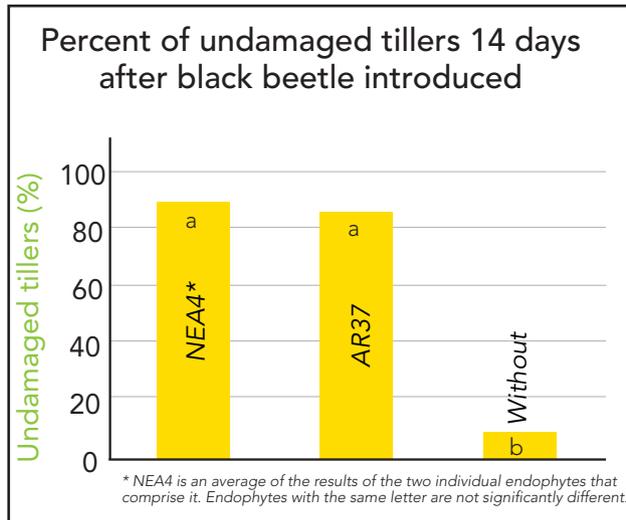
NEA gives a good level of black beetle control.

NEA, NEA2 and NEA4 endophyte provides good control of black beetle adults, limiting egg laying and larval numbers. To provide data NEA4 has been tested both in laboratory pot trials and in-paddock under high feeding pressure.

## 2016 pot trial

In this trial the same diploid perennial ryegrasses, infected with a range of endophytes and *Without* endophyte (WE), were tested for control of black beetle feeding, with 15 replications.

14 days after the introduction of the black beetle, large difference in their feeding preference were seen as shown in the graph below. In WE ryegrass only 9% of tillers were undamaged, compared to 88% undamaged in the same ryegrass with NEA4. There was no significant difference between NEA4 and AR37.



Ryegrass containing different endophytes were sown around pots, then black beetle introduced, with a choice of plants to feed on.

## 2014 St Peters School field trial

In this field trial very high levels of damage were noted in autumn, and ryegrass trial plots were scored for the level of black beetle feeding.

Large endophyte differences in black beetle feeding were recorded. The plots containing AR37, NEA4 and NEA2 had less than half the feeding damage than those WE or with AR1 endophyte control.

Results below are for the same perennial ryegrass cultivar containing different endophytes. 50 tillers per plot were assessed.

Endophyte	Black beetle tiller damage (%) 16th June 2014*
AR37	8.0 a
NEA4	9.5 a
NEA2	10.0 a
Without	24.9 b
AR1	25.2 b
Significance	***
LSD (5%)	6.1

\* Endophytes with the same letter are not significantly different.

# NEA2 & NEA4 = good Argentine stem weevil control

NEA2 & NEA4 give good control of Argentine stem weevil (ASW) in 2 ways.

NEA2 and NEA4 endophytes control ASW in two ways. First, adult ASW numbers are reduced as – simply put - they don't like the natural insecticide produced by these endophytes. This reduces adult populations.

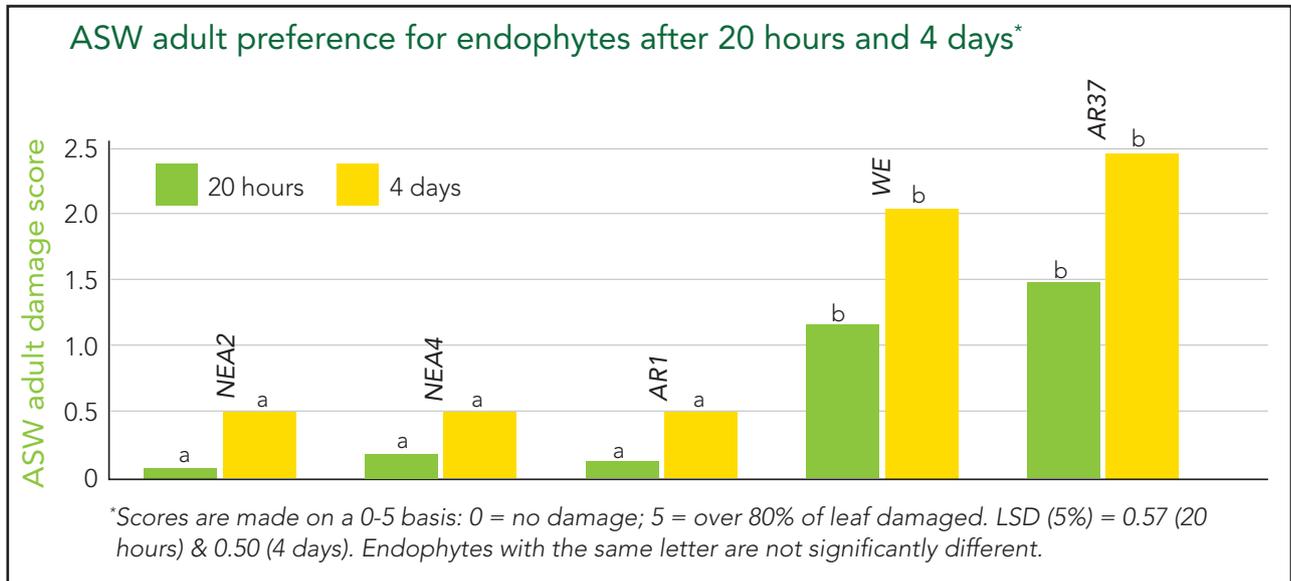
Second, any remaining adults egg laying is significantly reduced (see page 12). In combination these two factors give good ASW control.

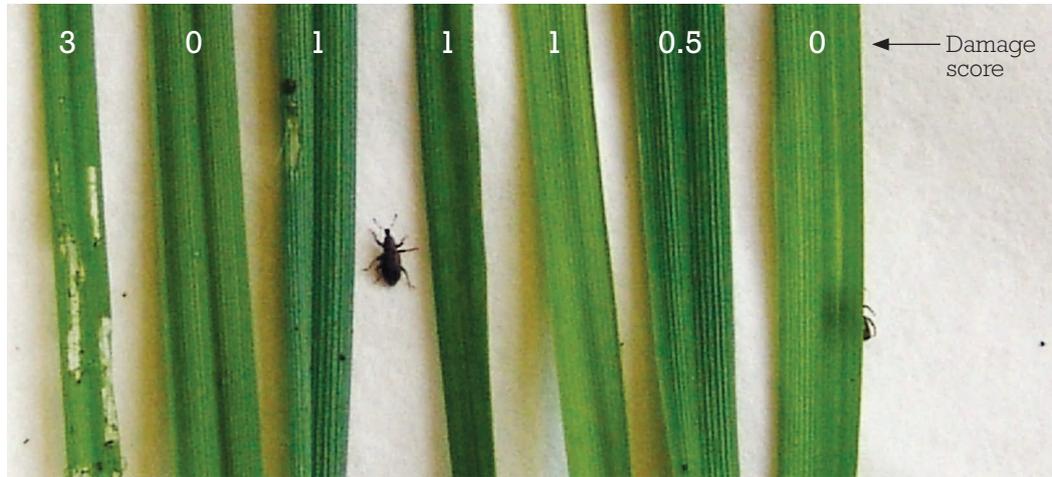
## Adult ASW feeding preference

This is objectively tested by putting adult ASW on ryegrass leaves of the same cultivar side by side in a petri dish, each with different endophytes, to compare their feeding.

Feeding can be clearly seen on some leaves after 4 days (see picture page 12), and is scored on a scale of 0 (no feeding) to 5 (extreme damage).

NEA4, NEA2 and AR1 endophytes provided significant control of ASW adults (see graph). AR37 had no effect on the weevils



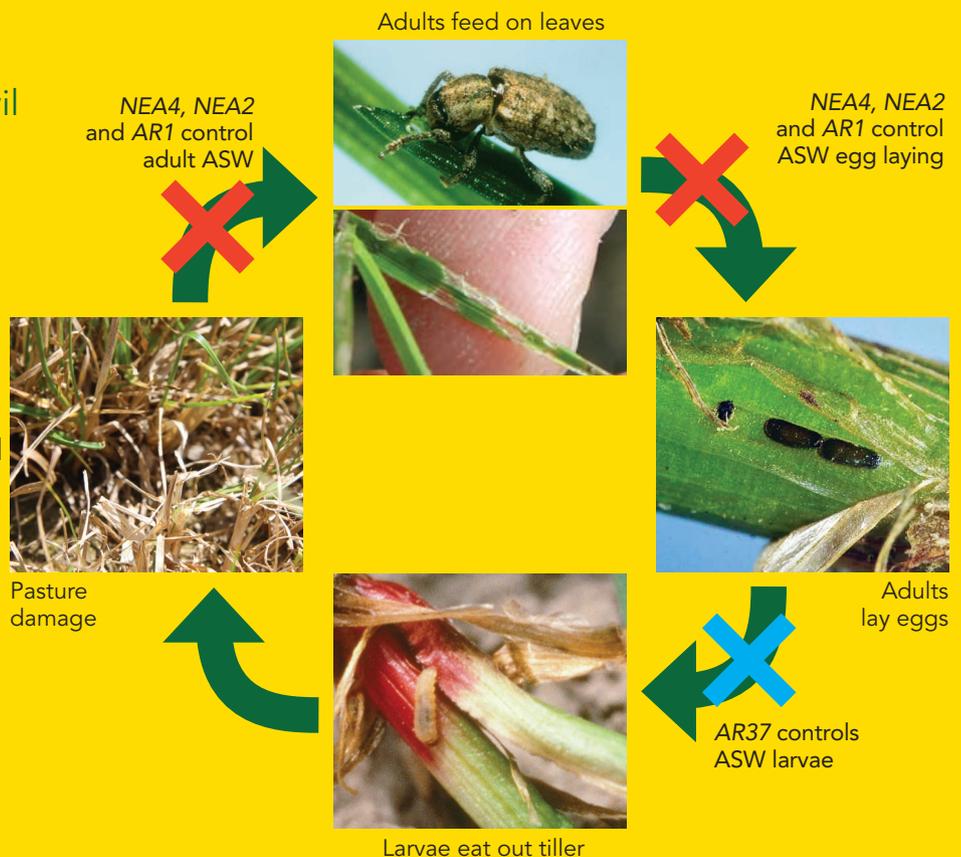


Given a choice, adult ASW greatly prefer the leaf with AR37 or without endophyte.

## Endophytes control Argentine stem weevil differently

**✗** NEA endophytes and AR1 control adult ASW. Plus also limit egg laying, so protecting pastures.

**✕** AR37 controls ASW larvae, stopping larval feeding, so protecting pastures.



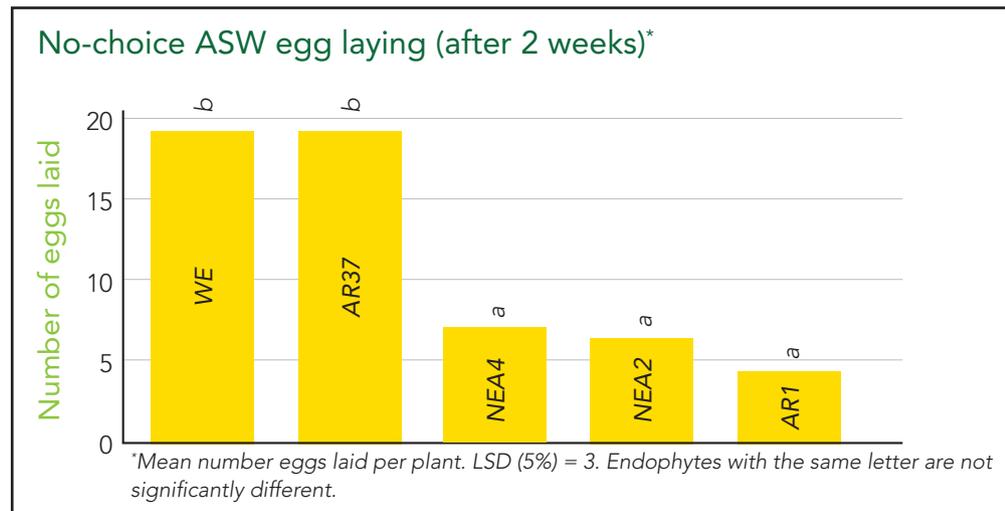
## ASW egg laying control

To measure endophyte control of egg laying 10 adult ASW were caged onto each individual plant of the same ryegrass cultivar with different endophytes.



*Each plant had 10 adult ASW caged onto it, and after 2 weeks the number of eggs laid were counted.*

NEA4, NEA2 or AR1 reduced egg laying by about two thirds (see graph). Conversely AR37 or WE ryegrass had no effect on the egg laying.

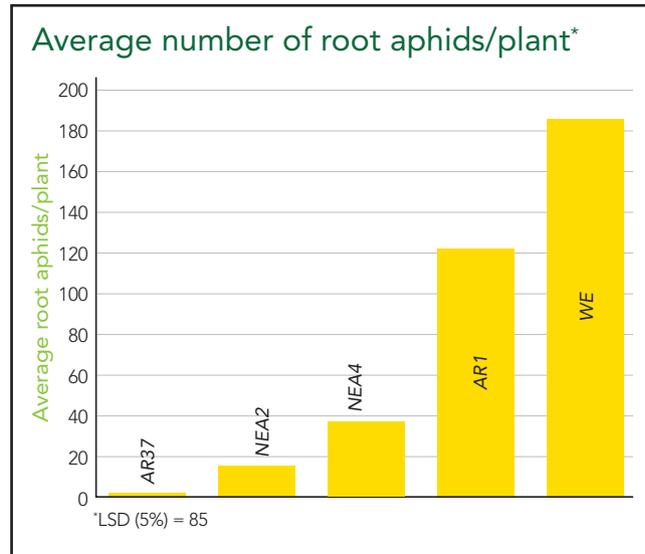


# NEA2 & NEA4 = moderate root aphid control

NEA2 & NEA4 give moderate control of root aphid (significantly better than AR1).

NEA2 and NEA4 have been tested for root aphid, and provide a moderate level of control, significantly higher than AR1, but less than AR37.

In the trial the same perennial ryegrass, with a range of different endophytes, were inoculated with root aphid. Over several months colonies developing both inside and outside their planter bags (see photo), and these root aphids were recovered and counted.



NEA4, NEA2, AR37 and SE ryegrass all had significantly fewer root aphids than ryegrass with either AR1 or WE.

# Industry insect ratings

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. The ratings in this table are based in part on glasshouse studies where test plants are 100% infected with endophyte, whereas commercial seed must meet minimum standards of 70% of seeds infected. These tables were compiled by AgResearch, Barenbrug, Cropmark, Grasslanz, PGG Wrightson Seeds, Seed Force and DLF.

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.

# Industry animal ratings

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

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