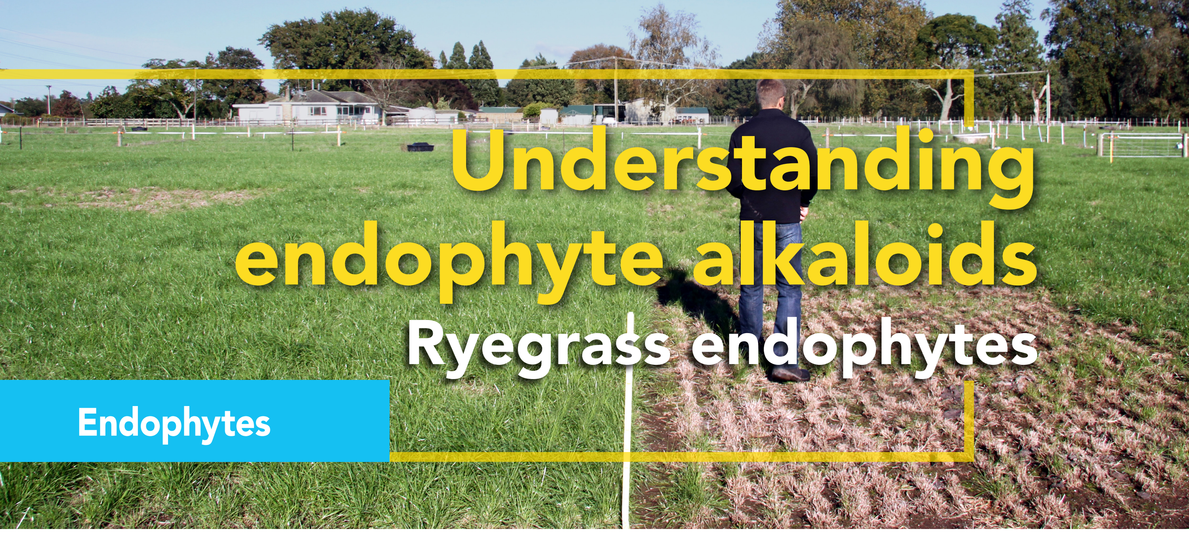


Understanding endophyte alkaloids

Ryegrass endophytes

Endophytes

Ryegrass endophytes produce different alkaloids (or chemicals)

Endophyte	Peramine	Lolitrem B	Ergovaline	Janthitrems	Lolines
*NEA, NEA2, NEA4**	✔	✔ (very low)	✔ (low-medium*)		
NEA12				✔	
AR1	✔				
AR37				✔	
CM142				✔	
RGT18				✔	
Standard	✔	✔ (high)	✔ (high)		
U2					✔

**With NEA, NEA2 and NEA4 endophytes ergovaline level is low in plant leaves, but higher in plant crown where insect control is most needed.*

Peramine

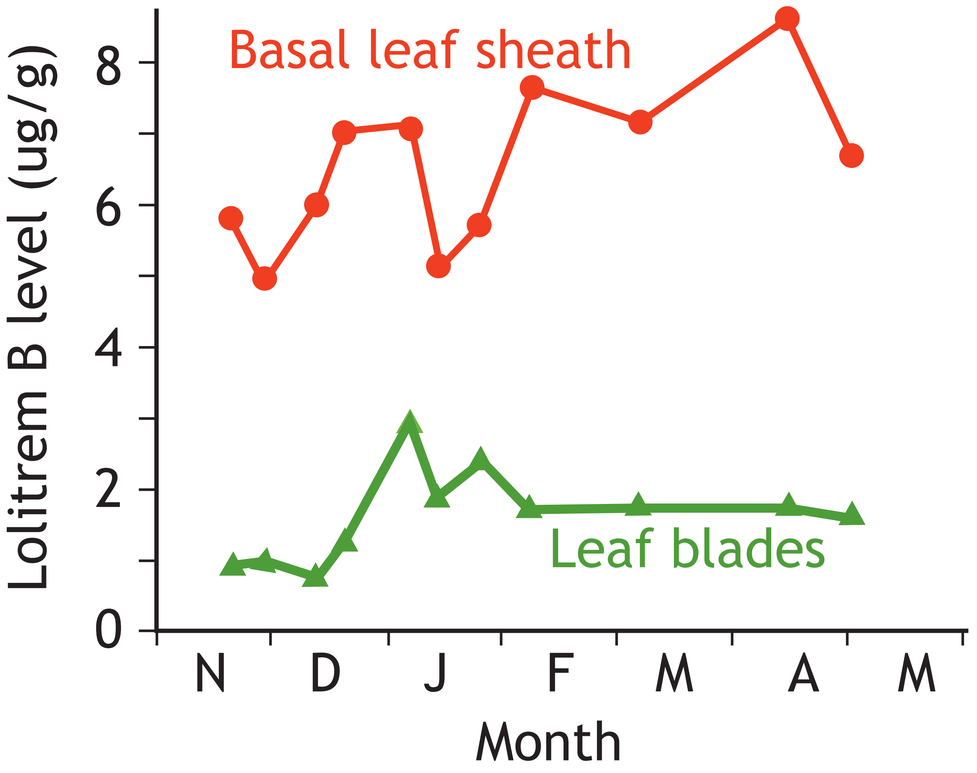
Peramine is an alkaloid produced by some ryegrass endophytes. It provides good control of the pasture pests Argentine stem weevil and pasture mealy bug. It is not known to have any adverse effect on animals.

Lolitrem B

Lolitrem B is the alkaloid produced by some ryegrass endophytes. At high levels it can cause ryegrass staggers or summer staggers in animals.

Animals grazing ryegrass with *Standard* endophyte (*SE*) are most likely to suffer staggers. Little seed with *SE* is sown nowadays, it is mainly found in old pastures. The worst staggers occurs when animals are pushed to graze into the base of plants in dry summers, or grazing the first pick of green growth following a dry spell. This is because lolitrem B is concentrated in the base of the plant (see graph).

Location of lolitrem B in pasture



Di Menna *et al.*(1992) NZ J.Ag.Res. 35:211-217

Lolitrem B is also found in seed heads (see Endophyte FAQ's), so grazing rank seedy pasture can also cause problems.

Staggers present as tremoring in mild cases and staggering in more severe cases. Animals rarely die directly from staggers, but may die through misadventure, such as drowning in streams.

Staggers causes severe management problems if stock must be regularly handled, e.g. milking cows. A low level of staggers usually clears up within 1-2 days if animals are fed a diet free from lolitrem B. Severe staggers can affect animals for weeks.

NEA, *NEA2* and *NEA4* endophytes produce very low levels of lolitrem B, so provide staggers free pasture for dairy cows and beef cattle. On sheep or deer farms, while ryegrass staggers is unlikely to occur, in dry summers if animals are forced to graze close to the ground a low level of staggers may be seen.

Lolitrem B is very stable in hay or silage so be careful buying or feeding these if they are made from *Standard* endophyte pasture.

Ergovaline

Ergovaline helps protect plants against insects, including black beetle and root aphid, but high levels

of ergovaline (e.g. from *Standard* endophyte) can sometimes reduce animal performance. *NEA, NEA2* and *NEA4* endophytes produce low to moderate levels of ergovaline which tests have shown are unlikely to affect animal health and performance under good grazing management.

The distribution of ergovaline through the plant differs for different endophytes. For *NEA, NEA2* and *NEA4*, ergovaline levels are very low in ryegrass leaves, but are moderate in the plant crown. This is an important benefit as leaves are your animals' main diet, whereas the crown of the plant, containing the growing point, needs protection from insect damage.

Animal health trials on *NEA2* endophyte in diploid ryegrass have shown the same lamb growth as those on the same ryegrass *Without* endophyte.

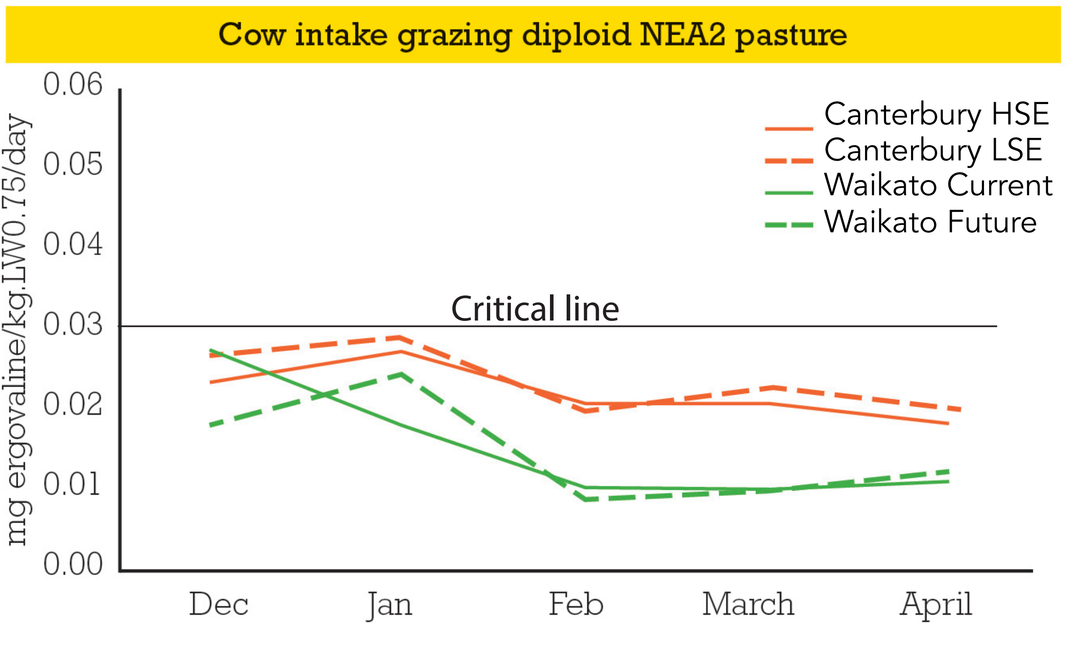
Lamb liveweight gain (LWG) in Lincoln University trials

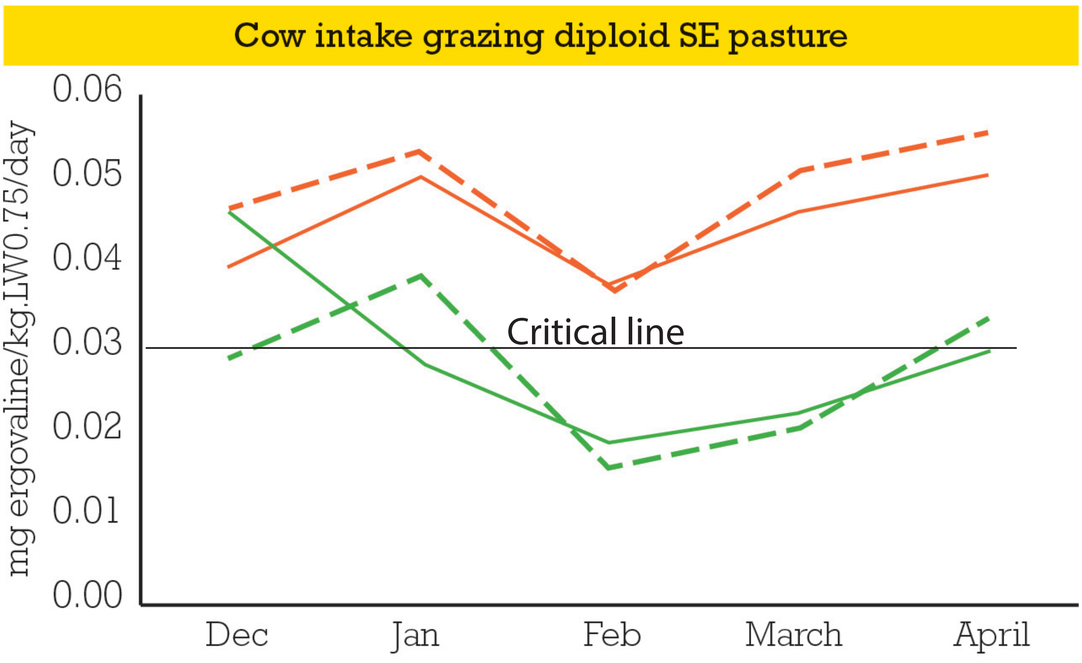
Measurement	*Without* endophyte	*NEA2*
kg LWG/ha/day	2.37 a	2.37 a
Relative LWG	100%	100%

Trials run on the same perennial ryegrass cultivar either with NEA2 or Without endophyte over four separate 8 week periods in autumn 2003, spring 2003, summer 2003-04 & autumn 2004. Significance lettering is given for LSD (5%) level.

Trials suggest the ergovaline eaten by dairy cows grazing well managed *NEA2*-based ryegrass pastures is unlikely to affect animal production. A review of animal intake research[1] showed ergovaline intakes below 0.03 mg/kg $LW^{0.75}$/day have never shown any effect on animal performance, with diploid *NEA2* pastures testing at below this safe level (see graph).

[1] *Nicol & Klotz. 2016. Animal Production Science 56:1775-1786*





** Ergovaline intakes in four DairyNZ farm systems. Eady et al. 2017 Proceedings NZ Grassland Association 79:205-210*

Calculated ergovaline intakes of cows grazing *Standard* endophyte were almost double those of *NEA2*.

The concentration of ergovaline in ryegrass is highest in the plant crown and seed head. Ergovaline increases in summer with rising temperature and seed head development, and in response to moisture stress. To minimise animal health issues keep pastures leafy through late spring, and try not to graze close to the ground in summer. Use other feeds (e.g. summer crops, silage, PKE, grain) to dilute alkaloid intake and greatly reduce the risk of any endophyte issues.

Janthitrems

Janthitrems are alkaloids produced by *NEA12*, *AR37*, *CM142* and *RGT18* endophytes. They produce no peramine, lolitrem B or ergovaline.

Janthitrem levels follow the seasonal pattern of other alkaloids, i.e. low in winter and high in late summer and autumn, and give a wide spectrum of insect resistance (see Endophyte insect control ratings).

High levels of janthitrems can cause staggers, although this is not as severe as that caused by *Standard* endophyte (see Endophyte animal safety ratings). In lamb LWG trials, ryegrasses with *NEA12* and *AR37* pastures can cause ryegrass staggers in sheep typically in dry summers where animals are pushed to eat into the base of pasture. This can be severe, and will impact animal health and growth.

Similar to lolitrem B, a low level of staggers usually clears up within 1-2 days if animals are fed a diet free from janthitrems. Severe staggers can affect animals for weeks.

In endophyte trials run by DairyNZ no ryegrass taggers have been seen in dairy cows grazing *AR37*. Although on occasion *AR37* has been shown to effect milksolids (MS) production, over the whole season MS production has been shown to be similar for *AR37* and *AR1*.

Lolines

Lolines are alkaloids produced by meadow fescue endophyte (*Neotyphodium uncinatum)*, and give a wide spectrum of insect resistance. They are produced at good levels in meadow fescue plants. But when these endophytes have been put into perennial ryegrass cultivars loline levels are typically much lower.

They are also translocated to the roots of the plant so can assist in deterring root feeding insects. weeks.

Black beetle have found and destroyed a trial plot of ryegrass Without endophyte at Newstead, Waikato. NEA, NEA2, NEA4, NEA12 and AR37 give good black beetle control.