Annual ryegrass seedbanks: The good, the bad, and the ugly

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KEY MESSAGES

- Annual ryegrass seedbanks diminish exponentially, but a small amount of seed can emerge at even 5 years after seed set.
- Seed dormancy is the main cause of the spread in emergence of ryegrass over time.
- Dormancy release can occur in two ways: 1) after-ripening, 2) dark-stratification.

AIM

To summarise results from research on annual ryegrass seed biology conducted over the last few years. We now have a new level of understanding that allows us to predict seed behaviour in the seedbank, and will enable us to improve the use of existing techniques and develop new ways to control ryegrass.

INTRODUCTION

At harvest, most seeds in a ryegrass population are dormant. These seeds lose dormancy during the summer. Dormancy release is a gradual and highly variable process; some populations might need only a few weeks, but others need a number of months.
Ideally, every seed would be non-dormant by the time it begins to rain at the start of the growing season. The non-dormant seeds will then germinate at the break and can be controlled with cultivation or knockdown herbicides prior to sowing the crop.
However, not all seeds will lose dormancy in one season. A proportion remains dormant and emerges after the crop has been sown. Some seeds will remain in the seedbank and emerge in future years: emergence has been observed following 5 years of complete seed set prevention (see Peltzer and Matson, 2002).
Thus the population can be segregated into 3 different proportions, the '*good, the bad, and the ugly*':

1. The ***Good***: Seeds that are non-dormant and germinate at or before the break of season.
2. The ***Bad***: Seeds that are dormant at the break of season, lose dormancy during the season and so emerge in-crop.
3. The ***Ugly***: Seeds that do not lose dormancy in the first season, forming part of the residual seedbank for future years

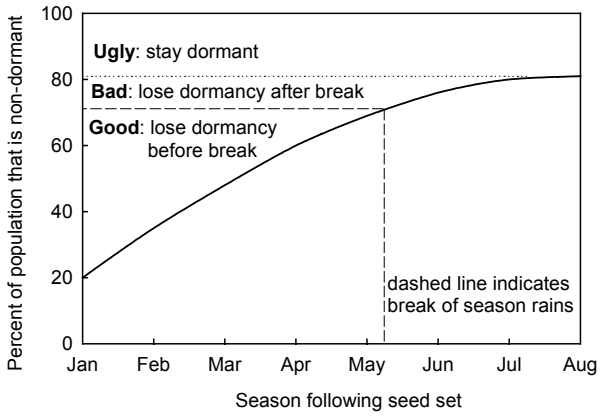

Figure 1. Typical graph showing the reduction in dormancy (increase in per cent of population that is non-dormant and able to germinate) during the season following seed set and maturation.

CLIMATE AND THE GOOD: BAD: UGLY

- Dormancy release is faster at higher temperatures, so there will be more *good* seeds and less *bad* seeds after a hot summer than a cool summer (see Steadman *et al*. 2003).
- When the break comes later in the year more seeds will be non-dormant (*good*) because they have had more time to lose dormancy than if the break comes early (see Steadman *et al*. 2003).
- Dormancy release is faster following a warmer September. This means that there will be more *good* seeds and less *bad* seeds if the seeds matured at a warmer temperature (see Ellery *et al*. 2003).
- Higher long term average temperature and rainfall correlate with less seeds retaining dormancy past the first season . So there will be less *ugly* seeds in warmer, wetter areas of the wheatbelt (see Ellery *et al*. 2003)

CULTIVATION AND THE GOOD: BAD: UGLY

Shallow cultivation at the break of season can stimulate emergence of annual ryegrass in the first year after seed set, but it is not effective on seeds that have been in the seedbank for more than one season (see Peltzer and Matson, 2002).
Cultivation changes the position of seeds in the soil, and so their access to light, nutrients, and water:

- Incorporation of *good* seeds: Seeds are non-dormant and will germinate if conditions are suitable. Incorporation enhances germination by improving contact with soil and water, i.e. providing better conditions for germination.
- Incorporation of *bad* and *ugly* seeds: Seeds are dormant and will not germinate even if conditions are perfect for germination.
- Incorporation of *bad* seeds may also put them in a position to lose dormancy fast, through 'dark-stratification'. Annual ryegrass seeds have a clever mechanism that allows fast removal of dormancy if seeds are wet and dark for around 2 weeks. Seeds become able to germinate when they next become exposed to light, which may happen during cultivation for weed control or at crop-seeding, resulting in a second flush of weed germination. Dark-stratification can remove dormancy at any time after seed maturation and so there are ways that we can make use of this phenomenon (see Steadman and Owen, 2003).

RELEVANT REFERENCES

Related papers in Crop Updates (Weeds) 2002 and 2003:

Peltzer and Matson (2002). Understanding the weed seedbank life of important agricultural weeds.

Ellery et al. (2003). Predicting annual ryegrass dormancy from climatic variables.

Steadman et al. (2003). Annual ryegrass seeds after-ripen faster during a hotter summer.

Steadman and Owen (2003). Removing dormancy in annual ryegrass seeds for early herbicide resistance testing.

KEY WORDS

annual ryegrass, *Lolium rigidum*, seed dormancy, seedbank dynamics

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