SOUTHERN
SEPTEMBER 2018

GRDC GROWNOTES™

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION

CEREAL RYE

SECTION 3

PLANTING

SEED TREATMENTS | TIME OF SOWING | TARGETED PLANT POPULATION | CALCULATING SEED REQUIREMENTS | SOWING DEPTH | SOWING EQUIPMENT

Planting

Key messages

- Rye for grain is sown at the same time as wheat, oats or barley (April–June), although it is often sown first because rapid groundcover is normally desirable on the soils where it is sown.
- Target plant recommendations are 120–150 plants per m^2 for grazing and grain crops, or a seeding rate of ~60–70 kg per hectare. Larger populations are needed for green manure crops. [1]
- Seed should be drilled to about 2.0–2.5 cm deep in heavy soils, 3.5–4.5 cm in sandy soils. [2]
- Allow 15–18 cm between rows when seeds are drilled. [3]

3.1 Seed treatments

Seed treatments are applied to control diseases such as smuts, bunts or rust, and insects. When applying seed treatments, always read the chemical label and calibrate the applicator. Seed treatments are best used in conjunction with other disease-management options such as crop and paddock rotation, clean seed and resistant varieties, especially when managing diseases such as stripe rust.

There are risks associated with using seed treatments. Some seed treatments can delay emergence by:

- slowing the rate of germination, or
- shortening the length of the coleoptile, the first leaf and the sub-crown internode.

If there is a delay in emergence due to decreased vigour, it increases exposure to pre-emergent attack by pests and pathogens, or to soil crusting. This may lead to a failure to emerge. The risk of emergence failure increases when seed is sown too deeply or into a poorly prepared seedbed, especially for varieties with shorter coleoptiles. As the amount of some fungicides increases, the germination rate slows (Figure 1). [4]

1 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

2 Agriculture Victoria (2013) Growing cereal rye, Victorian State Government EDJTR, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

3 Plant Village. Rye: *Secale cereale*. Penn State Extension, https://www.plantvillage.org/en/topics/rye/diseases_and_pests_description_uses_propagation

4 NSW DPI District Agronomists (2007) Wheat growth and development. PROCROP Series, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/growth-and-development

MORE INFORMATION

PIRSA: Cereal seed treatments 2017

GRDC fact Sheet: Targeted nutrition at sowing

VIDEOS

WATCH: GCTV Extension files: Wheat sowing strategies

WATCH: GCTV Extension files: Early sowing opportunities

WATCH: Early sowing in the LRZ

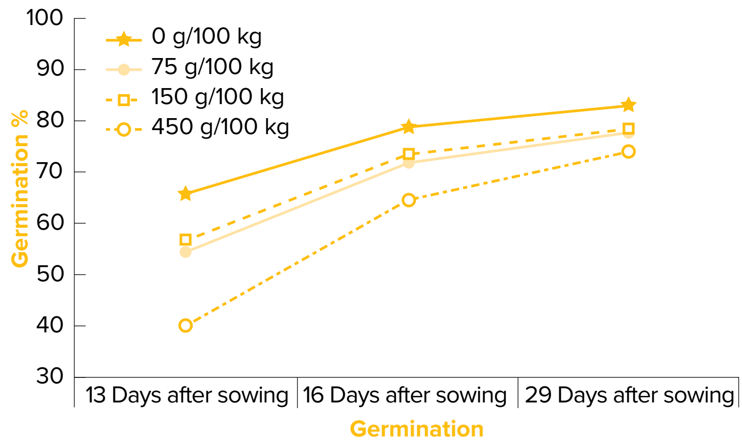


Figure 1: *Impact of seed-treatment fungicide on the rate of germination.* [5]

Source: based on P Cornish 1986

Product registrations change over time and may differ between states and between products containing the same active ingredient. Prior to use, it is critical to check the registration status on the current product label for the intended use pattern in your state.

3.1.1 Emergence problems

Factors other than seed treatments can cause poor seedling emergence, including deep sowing, surface crusting, use of short coleoptile varieties, suboptimal soil temperatures, and the pre-emergent herbicide trifluralin.

Sowing too deep is a common cause of emergence problems. The coleoptile, which surrounds the first leaf until the shoot emerges, protects and guides the shoot as it grows through the soil. If seed is sown deeper than the length of the coleoptile, the plant can fail to emerge.

Because coleoptile lengths vary among varieties, some can tolerate deeper sowing than others. Coleoptile lengths also vary greatly from one batch of seed to another. Seed source is often more critical than variety in determining coleoptile length. Therefore, farmers should seek to use the best seed possible.

Most emergence problems occur in heavy clay soils where surface sealing occurs. Extra care is required when treated seed and/or trifluralin is used in such soils. [6]

3.1.2 Fertiliser at seeding

The amount of nitrogen (N) safely placed with the seed will vary depending on soil texture, amount of seedbed utilisation and moisture conditions. Higher rates of N can be safely applied with the seed if it is a polymerised form of urea, from which the N is released over several weeks. If soil moisture is marginal for germination, high rates of fertiliser should not be placed with the seed. Nitrogen can be banded prior to seeding, but take care to avoid loss of seedbed moisture and protective crop residue. Place phosphorous with or near the seed at seeding time. [7]

5 P Cornish (1986) Effects of a triadimefon–lindane seed treatment on the germination, seedling morphology and emergence of wheat. *Australian Journal of Experimental Agriculture* 26, 227–230, http://www.publish.csiro.au/an/EA9860227

6 H Wallwork H (2017) Cereal seed treatments 2016. PIRSA, http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/237920/cerealseedtreat2017_web.pdf

7 Alberta Government (2016) Fall rye production. Alberta Agriculture and Forestry, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1269/$file/117_20-1.pdf

VIDEOS

WATCH: GCTV15: Optimal flowering—follow up

WATCH: Over the Fence South: Early sowing protects crops from winter wet

MORE INFORMATION

GRDC Fact Sheet: Time of Sowing Factsheet—Southern Region

3.2 Time of sowing

Rye for grain is sown at the same time as wheat, oats or barley (April–June). Because rapid groundcover is usually required on the soils where rye is sown, it is often sown first.

If seasonal conditions are unfavourable for pasture growth in the Mallee, cereal rye is often sown dry during March for green feed, in which case the sowing rate should be increased to 80–100 kg per hectare to maximise fodder production. Graze when plants are 150 mm high and tillering. The later stages of growth are stemmy and unpalatable to stock. Cereal rye is generally not a suitable hay crop.

For the purposes of green manure, cereal rye can be sown in February or March or as late as August in high-rainfall areas. [8]

Best results are generally obtained from early-sown rye crops. If sufficient moisture is available, it may be sown in the last half of February for early green feed. [9]

3.3 Targeted plant population

Target plant numbers to account for differences in tillering capacity:

- A seed germination and viability test should be performed if you think there may be a problem, such as after a drought or late frost, or if seed is old.
- Check 1000-seed weight from each seedlot each year.
- Alter sowing rates to account for target population, seed size and germination. [10]

Plant population, determined by seeding rate and establishment percentage, can be an important determinant of tiller density and, at a later stage, head density. [11]

Target plant densities should reflect the tillering capacity of the variety. Low-tillering varieties should be sown at higher plant densities than high-tillering varieties to achieve target tiller numbers.

Target tiller numbers relate to the number of tillers that can be sustained to produce optimum yields. This often relates to rainfall, e.g. the target tiller number for 500-mm rainfall zone is ~500 tillers per m^2.

Seed size influences plant density, with large seeds requiring a higher sowing rate than smaller seeds to target the same population. The 1000-seed weight is a measure of seed size and should be determined for each seedlot, because results vary depending on the age of seed and the conditions under which it has been grown. [12]

Despite the crop's ability to compensate, targeting a variety's optimum plant density at sowing makes the most efficient use of water and nutrients. To reach a target plant population for the environment and seasonal conditions, adjust sowing rates to allow for:

- sowing date—higher rates with later sowings
- seed germination percentage
- seed size
- seedbed conditions
- tillage, e.g. no-till
- double-cropping

8 Agriculture Victoria (2013) Growing cereal rye. Victorian State Government EDJTR, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

9 RL Reid (Ed.) (1990) The manual of Australian agriculture. Elsevier.

10 K Condon (2003) Targeting optimum plant numbers. NSW Agriculture, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/168523/targeting-optimum-plant-numbers.pdf

11 G Butler, W Manning, L Serafin (2003) Population density studies in sorghum and wheat. GRDC Update Papers, 19 September 2003, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2003/09/Population-density-studies-in-sorghum-and-wheat

12 K Condon (2003) Targeting optimum plant numbers. NSW Agriculture, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/168523/targeting-optimum-plant-numbers.pdf

- soil fertility
- soil type
- soil moisture and seasonal outlook
- weed-seed burden—higher sowing rates for increased plant competition, e.g. if combatting herbicide-resistant ryegrass populations. [13]

IN FOCUS

Effect of seeding rate and planting arrangement on rye cover crop and weed growth.

Weed growth in winter cover crops in warm climates may contribute to weed-management costs in subsequent crops. A two-year experiment was conducted on an organic vegetable farm in the USA to determine the impact of seeding rate and planting arrangement on rye cover crop growth and weed suppression. Each year, rye was planted at three rates (90, 180, and 270 kg/ha) and two planting arrangements (one-way *v.* grid pattern). Averaged across years, rye population densities were 322, 572, and 857 plants/m^2 at the 90, 180, and 270 kg/ha seeding rates, respectively. Early-season rye groundcover increased with seeding rate and was higher in the grid than the one-way arrangement in year 1; however, rye groundcover was not affected by rate and was higher in the one-way arrangement in year 2. Aboveground dry matter (DM) of rye increased with seeding rate at the first two harvests but not at the final one. Planting arrangement did not affect rye aboveground DM in year 1, but rye DM was higher in the grid pattern at the first and final harvests in Year 2. Weed emergence was not affected by seeding rate or planting arrangement. Weed biomass decreased with increased seeding rate and was lower in the grid than in the one-way arrangement in year 2. A grid planting pattern provided no consistent benefit but planting rye at higher seeding rates maximises early season rye DM production and minimises weed growth. [14]

TOPCROP Victoria investigated sowing rates for wheat to achieve target plant densities in large-scale paddock demonstrations during the 2000 season. TOPCROP farmer groups established 30 sites across Victoria comparing 75%, 100%, 150% and 200% of the district practice for sowing rate. Findings indicated that poor seeder calibration and a lack of understanding of the influence of grain size led to target plant densities not being reached. This highlights the need for sowing recommendations to be based on target plant densities rather than sowing rates. [15]

13 NSW DPI District Agronomists (2007) Wheat growth and development. PROCROP Series, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/growth-and-development

14 NS Boyd, EB Brennan, RF Smith, R Yokota (2009) Effect of seeding rate and planting arrangement on rye cover crop and weed growth. *Agronomy Journal* 101, 47–51.

15 A Johnson, M Evans, K Wansink (2001) Challenging sowing rates for wheat to achieve target plant densities, 10th Australian Agronomy Conference, Australian Society of Agronomy/The Regional Institute Ltd, http://agronomyaustraliaproceedings.org/images/sampledata/2001/p/10/johnson.pdf

3.4 Calculating seed requirements

Farmer observations suggest that sowing rye at low rates may make the crop easier to harvest. [16] Cereal rye is tall and the bulky straw makes harvest slow due to the large volume going through the harvester. [17]

Rate of sowing can vary from 40 to 135 kg/ha, with higher rates being used when seed is broadcast for green feed. The usual sowing rate when drilled is 60–70 kg/ha. [18]

Sowing rates vary with seed size, target plant population and establishment percentage. Growers should target 120–150 plants per m^2 for grazing and grain crops. Higher population densities are needed for green manure crops. Comparative seed rates for grazing and grain crops are 60–70 kg/ha and for green manure 80–100 kg/ha. [19]

IN FOCUS

Agronomic requirements for a semi-dwarf rye variety: phosphorus and sowing rate.

Cereal rye has a valuable role in controlling soil erosion on sand ridges and related light soil types. Breeding work at the Waite Agricultural Research Institute produced semi-dwarf, high-yielding lines and this study was designed to determine the rates of P and sowing required to realise their greater yield potential compared with SA Commercial.

A trial was sown on 14 June 1988 at Lameroo to compare the responses to sowing rate of a semi-dwarf rye variety (B88) and SA Commercial. The June–November rainfall was 210 mm, 10% below average. A split-plot design was used with varieties as the main treatments and six sowing rates (25, 40, 55, 70, 85, 100 kg/ha) as subplots. The trial received 12 kg P and 5 kg N/ha applied as mono-ammonium phosphate.

Sowing rate had no significant effect on yield in 1987 but a significant variety × sowing rate response occurred in the 1988 trial (Figure 2). B88 showed little response to sowing rate but the yield of SA Commercial decreased with increasing sowing rate. More tillers of SA Commercial died at the higher sowing rates and it lodged late in the season. The reduction in yield of this variety at high sowing rates was associated with a greater reduction in grain weight. This was possibly due to the combined effects of lodging and a dry spring during the grain-filling phase. The study showed that the P rates and sowing rates used for rye are unlikely to limit the yield potential of the semi-dwarf lines. [20]

16 NRSA (2014) Managing land classes for better feed utilisation—producer case study. Natural Resources SA, http://www.naturalresources.sa.gov.au/files/e7e04254-1bae-4763-9400-a38700980519/managing-land-classes-for-better-feed-utilisation-walsh-case-study-gen.pdf

17 P Matthews, D McCaffery, L Jenkins L (2016) Winter crop variety sowing guide 2016. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

18 RL Reid (Ed.) (1990) The manual of Australian agriculture. Elsevier.

19 P Matthews, D McCaffery, L Jenkins L (2016) Winter crop variety sowing guide 2016. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

20 G Dean, G McDonald (1989) Agronomic requirements of a new semi-dwarf variety 1: Phosphorus and sowing rate. 5th Australian Agronomy Conference, http://www.regional.org.au/au/asa/1989/contributed/plant-nutrition/p-03.htm

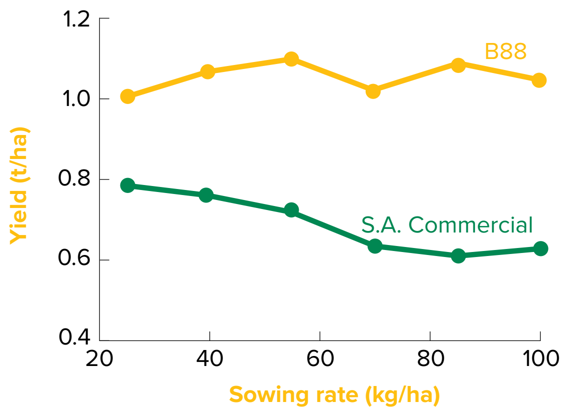


Figure 2: *Grain yield response of the semi-dwarf B88 and SA Commercial cereal rye to sowing rate.*

Because seed sizes may vary depending on production years and variety type, a fixed quote for the seed weight needed to sow one hectare is not always an accurate for obtaining a desired plant population. Average graded seed sizes are:

- large, 24,000 seeds/kg
- medium, 27,500 seeds/kg
- small, 30,000 seeds/kg.

The following formula (Figure 3) can be used to calculate sowing rates, taking into account:

- target plant density
- germination percentage
- seed size
- establishment, usually 80%, unless sowing into adverse conditions.

To calculate 1000-seed weight:

- count out 200 seeds
- weigh to accuracy of at least 0.1 g
- multiply weight (g) by 5. [21]

21 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2014. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

Example

1000 seed weight (grams)		target plant population (/m²)			establishment % X germination %
35	X	140	X 100	÷	80 X 90

= Your seedling rate 68 kg/ha

Your calculation

1000 seed weight (grams)		target plant population (/m²)			establishment % X germination %
______	X	______	X 100	÷	______

= Your seedling rate ______ kg/ha

Figure 3: *Seeding rate calculator.*

Source: NSW DPI Winter crop variety guide

3.5 Sowing depth

Optimum planting depth varies with planting moisture, soil type, seasonal conditions, climatic conditions, and the rate at which the seedbed dries. The general rule is to plant as shallow as possible, provided the seed is placed in the moisture zone, but deep enough that the drying front will not reach the seedling roots before leaf emergence. [22] Also, it is important to separate the seed from any pre-emergent herbicides used. [23]

Sowing depth for cereal rye should not exceed 5 cm. Bevy rye should be sown at depths not exceeding 2.0–2.5 cm in heavy soils and 3.5–4.5 cm in sands. [24]

Research in Canada has shown that rye sown at a 2.5 cm depth has twice the emergence of that sown at ~5 cm and that shallow-seeded rye had greater winter hardiness. [25]

Rye has four primary roots that originate from the seed and it can send out roots and tillers from the second, third and fourth node. This extensive root system within the first 30 cm of soil is more developed than in other cereals. This makes rye useful for sowing over eroded or disturbed sites, where depth is hard to control, and makes the plant more drought-resistant. [26]

Seed size influences coleoptile length, which is sensitive to sowing depth. Sowing depth influences the rate of emergence and the emergence percentage. Deeper seed placement slows emergence; this is equivalent to sowing later. Seedlings emerging from greater depth are also weaker, more prone to seedling diseases, and tiller poorly.

22 QDAF (2012) Wheat planting information. Queensland Department of Agriculture and Fisheries, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/planting-information

23 S Kleemann, J Desbiolles, G Gill, C Preston (2015) Seeding systems and pre emergence herbicides Coonabarabran. GRDC Update Papers, Feb. 2015, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Seeding-systems-and-pre-emergence-herbicides-Coonabarabran

24 Agriculture Victoria (2013) Growing cereal rye. Victorian State Government EDJTR, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

25 Alberta Government (2016) Fall rye production. Alberta Agriculture and Forestry, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1269/$file/117_20-1.pdf

26 L Martin (2015) Growing cereal rye to increase carbon and prevent wind erosion. Leibe Group, http://www.liebegroup.org.au/wp-content/uploads/2015/03/Case-Study-Jeff-Pearse-March-2015.pdf

Crop emergence is reduced with deeper sowing because the coleoptile may stop growing before it reaches the soil surface, with the first leaf emerging from the coleoptile while it is still below the soil surface. As it is not adapted to pushing through soil (does not know which way is up) the leaf usually buckles and crumples, failing to emerge and eventually dying. [27]

For more information, see Section 4: Plant growth and physiology.

3.6 Sowing equipment

Seeder calibration is important for precise seed placement and seeders need to be checked regularly during sowing (Photo 1).

Most growers in the Southern Region use either a tyne system with knife-points and press-wheels or a single disc. Disc seeders can handle greater quantities of stubble but experience crop damage issues with pre-emergent herbicide use. Tyne seeding systems do not have the same herbicide safety issues but usually require some form of post-harvest stubble treatment, such as mulching or burning.

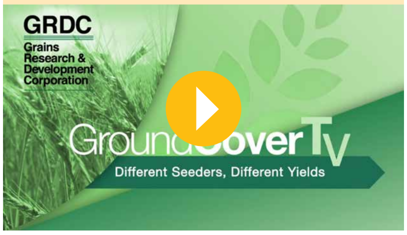
Photo 1: *Seeder calibration is important for precise seed placement, and seeders need to be checked regularly during sowing.*

Photo: Rohan Rainbow

VIDEOS

WATCH: SFS seeder trial.

WATCH: GCTV19: Different seeders different yields. Local R&D – valuable solutions for the HRZ grain growers.



27 NSW DPI Agronomists (2007) Wheat growth and development. PROCROP Series. NSW Department of Primary Industries 2007, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/winter-crops/wheat,-barley-and-other-winter-cereals/growth-and-development