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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

# VETCH

## SECTION 4

## PLANT GROWTH AND PHYSIOLOGY

# Plant growth and physiology

## Key messages

- Vetch is an annual legume with semi-prostrate growth and many lateral branches bearing medium to long pods.
- Vetch uses a similar growth stage guide to lentil.
- Vetch establishment after autumn rains is significantly faster than medics and clovers; reaching 6–10 nodes (10–15 cm) in 6–8 weeks.
- Like many pulses, vetch germination and emergence rate can be decreased due to chemical residues.
- Temperature and photoperiod will also influence vetch establishment and growth.

## 4.1.1 Common vetch (*Vitcia sativa*)

Key characteristics:

- Plant: annual, moderate stem strength and grows as small bushes. 40–80 cm high, with multiple lateral branches from near the base.
- Stems: large climbing semi-prostrate with 9–16 internodes with multiple green to dark green leaves.
- Leaves: concave, green, hairy on both sides. The central leaf stalk contains 4–8 pair of leaves with a tendril on the top.
- Flowers: single or pair, medium (10–35 mm); colour-violet/purple or white.
- Pods: length-medium to long (40–70 mm); with 6–8 seeds.
- Seeds: medium to large (100seeds = 6.5–8.9 g); testa - brownish ornamentation; cotyledons colour:
- Morava(D and Languedoc - beige;
- Rasina(D - greenish;
- Blanchefleur - red/orange;
- Softness:
- Morava(D 99–100%;
- Rasina(D 95–100%;
- Blanchefleur and Languedoc 80–95%. [1]

## 4.1.2 Woolly pod vetch (*Vicia villosa*)

Key characteristics:

- Plant: winter growing annual, with multiple laterals branching from near the base (Photo 1).
- Stems: weak stemmed climbing, 40–120 cm high, green and hairy.
- Leaflets: two pair, narrow green leaflets. The central leaf stalk containing 5–10 pair of leaves with a tendril on the top.
- Flowers: small with multiple petals 5–20 (10–20 mm); colour-violet/purple.
- Pods: length 20–30 mm by 7–10 mm with 2–5 seeds.
- Seed: small to medium (100 seeds = 3.5–5.5 g). [2]

Varieties include Capello(D, Haymaker(D, Namoi and RM4(D.

1 R Matic, S Nagel, G Kirby (2008) Common Vetch. Pastures Australia. http://keys.lucidcentral.org/keys/v3/pastures/Html/Common_vetch.htm

2 R Matic, S Nagel, G Kirby (2008) Woolly pod Vetch. Pastures Australia. http://keys.lucidcentral.org/keys/v3/pastures/Html/Woolly_pod_vetch.htm

**Photo 1:** *Vetch plant at flowering.*

Photo: Stuart Nagel

### 4.1.3 Purple vetch (*Vicia benghalensis*)

Key characteristics:

- Plant: winter growing annual, with multiple laterals branching from near the base. Initial growth is slow.
- Stems: in early stages it is more erect than any other Vicia spp. Growth 40–100 cm high.
- Leaflets: two pair, narrow green leaflets. The central leaf stalk containing 5–9 pair of oblong narrow leaves with a branched tendril on the top.
- Flowers: small with multiple, 5–20 (10–20 mm); colour-violet/purple.
- Pods: length 25–40 mm by 8–11 mm with 3–5 seeds.
- Seed: is black and very distinctive, with a white hilum, compared to other vetch seeds, small to medium (100seeds=4.0–4.5 g). [3]

Varieties include Popany which has 5–10% hard seeds.

## 4.2 Plant growth stages

### 4.2.1 Vegetative growth stage

Vegetative growth stages are described by counting nodes on the main stem and continuing the count up the basal primary branch to include the highest fully developed leaf. Reproductive stages R1 and R2 are based on flowering, R3 to R6 on pod and seed development, and R7 and R8 on maturation.

Count the number of visible nodes on the main stem up to the node subtending the basal primary branch, and then continuing the node count up the basal primary branch to include the highest fully developed leaf.

- VE – seedling emergence, cotyledonary node visible
- V1 – the first simple leaf has unfolded at the first node

3 R Matic, S Nagel, G Kirby (2008) Woolly pod Vetch. Pastures Australia. http://keys.lucidcentral.org/keys/v3/pastures/Html/Purple_vetch.htm

- V2 – the second simple leaf has unfolded at the second node
- V3 – the first bifoliate leaf has unfolded at the third node
- V4 – the second bifoliate leaf has unfolded at the fourth node
- V5 – the first multifoliate leaf has unfolded at the fifth node
- Vn – the nth multifoliate leaf has unfolded at the nth node. [4]

Vetch leaves are very similar to those of lentils and the two can be confused, especially in the early growth stages (Figure 1).

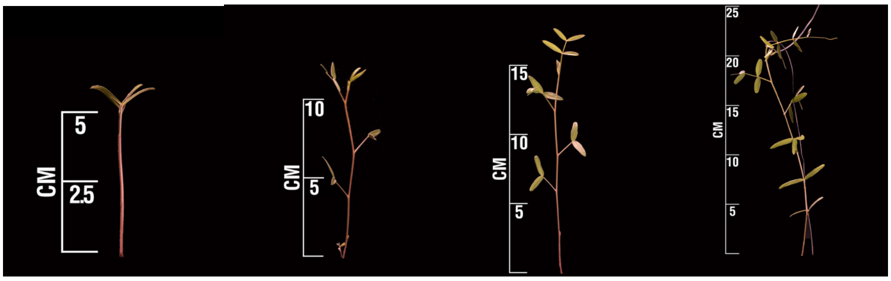


**Figure 1:** *Vetch during vegetative growth at the 1, 4, 5 and 6 node stages.*

In vetch growth, there is often a sequence of leaf, flower bud, flower and pod development along each branch.

## 4.2.2 Reproductive stage

Reproductive stages are based on flowering, pod and seed development, and on maturation. Flowering in lentil is indeterminate, occurring from axillary buds on the main stem and branches. It proceeds acropetally from lower to higher nodes.

- R1 – early bloom, one open flower at any node (Figure 2 and Photo 2)
- R2 – full bloom, flower open or has opened on nodes 10–13 of the basal primary branch
- R3 – early pod, pod on nodes 10–13 of the basal primary branch visible
- R4 – flat pod, pod on nodes 10–13 has reached its full length and is largely flat.
- R5 – early seed, seed in any single pod on nodes 10–13 fill the pod cavity
- R6 - full seed, seed on nodes 10–13 fill the pod cavities. [5]

4 Descriptors adapted from the paper by W. Erskine, F. J. Muehlbauer and R. W. Short. 1990. Stages of Development in Lentil. Exp. Agric. 26:297–302. Sourced from: NDSU https://www.ndsu.edu/pubweb/pulse-info/growthstages-pdf/LentilGrowthStages.pdf

5 Descriptors adapted from the paper by W. Erskine, F. J. Muehlbauer and R. W. Short. 1990. Stages of Development in Lentil. Exp. Agric. 26:297–302. Sourced from: NDSU https://www.ndsu.edu/pubweb/pulse-info/growthstages-pdf/LentilGrowthStages.pdf


**Figure 2:** *Vetch plant at the early flowering stage.*

**Photo 2:** *Common vetch flower.*

Photo: Stuart Nagel

Common vetch pods are medium to long in length (40–70 mm) with 6–8 seeds (Figure 3). Woolly pod vetch pods are 20–30 mm by 7–10 mm, with 2–5 seeds.

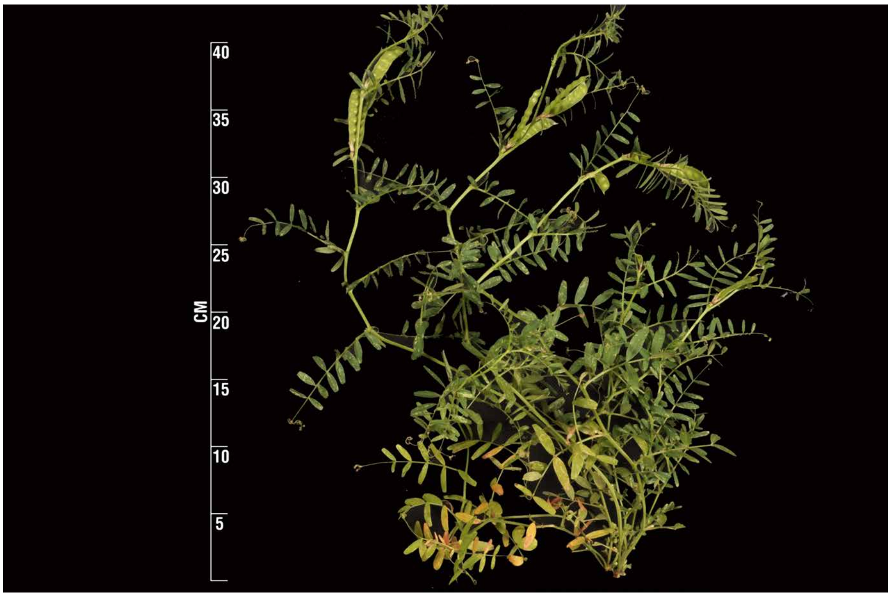


**Figure 3:** *Vetch plant at pod fill.*

### 4.2.3 Physiological Maturity

- R7 – the leaves start yellowing and 50% of the pods have turned yellow
- R8 – 90% of pods on the plant are golden-brown (Figure 4). [6]


**Figure 4:** *Vetch at growth stage R8.*

6 Descriptors adapted from the paper by W. Erskine, F. J. Muehlbauer and R. W. Short. 1990. Stages of Development in Lentil. Exp. Agric. 26:297–302. Sourced from: NDSU https://www.ndsu.edu/pubweb/pulse-info/growthstages-pdf/LentilGrowthStages.pdf

## 4.3 Germination and emergence issues

Key points:

- Vetch establishment after autumn rains is significantly faster than medics and clovers; reaching 6–10 nodes (10–15 cm) in 6–8 weeks. [7]
- Vetch has strong seedling vigour and has vigourous growth once it is well-established. [8]
- Common vetch has better initial growth and early vigour and better palatability from emergence to mature plants when compared with hairy, bitter and purple vetches. [9]

Germination and emergence are important stages in the life cycle of plants that determine the efficient use of the nutrients and water resources available to plants. The physiological process of germination depends on several environmental factors such as temperature, water potential, light and nutrients. Water and temperature are determinant factors for seed germination, with both factors, separately or jointly, affecting the germination percentage and rate.

Vetch plants are hypogeal, like field pea (Figure 5), which means the cotyledons of the germinating seed remain below the ground and inside the seed coat. Seedlings with hypogeal emergence are less likely to be killed by frost, wind erosion or insect attack as new stems can develop from buds at nodes at or below ground level. Their growth may however be slowed considerably. [10]

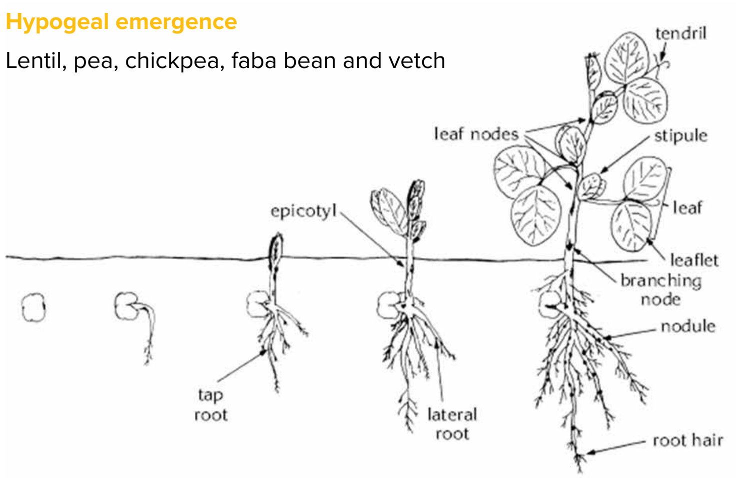


**Figure 5:** *Hypogeal emergence protects lentil seedlings from the effects of frost and insect damage at crop establishment.*

Source: Pulse Australia

For more information on germination and emergence issues, see the section below.

### 4.3.1 Sowing depth

Depth of sowing is an important agronomic practice affecting the emergence and establishment of crops, especially with early sowing under dryland conditions when temperatures and soil evaporation rates are high.

7 R Matic, S Nagel, G Kirby (2008) Common Vetch. Pastures Australia. http://keys.lucidcentral.org/keys/v3/pastures/Html/Common_vetch.htm

8 J Frame. Vicia sativa L. FAO. http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=238003

9 R Matic (2014) GRDC Final Report: DAS00059 – Improved vetch varieties for Australian farmers and end-users. https://grdc.com.au/research/reports/report?id=1104

10 Pulse Australia. (2015). Lentil production: Southern region. http://pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

Sowing depth is the key to uniform, fast emergence and establishment. There is a maximum depth at which the pulse crop can be safely sown to avoid poor establishment and lower seedling vigour. Sowing seed outside the suggested range above will delay emergence and slow seedling growth. Actual sowing depth should be shallower on clay soils and hard setting soils and deeper on sands. Vetch, lentils, peas and chickpeas have intermediate tolerance to deep sowing.

Depending on paddock conditions, avoid deep planting as vetch seedlings can be weak. [11]

Vetch should be sown at 3–5 cm and if applying a pre-emergent herbicide vetch should be sown at 5 cm. [12]

### Sowing depth and herbicide interaction

Pulses can be more tolerant and are able to emerge if shallow sowing is avoided. The actual depth of sowing will depend on the soil type. Herbicides leach deeper in sands than in clay soils. Some herbicides leach more than others, and heavy rain onto a dry soil surface, particularly on a sand, is worst.

For more information, see Section 3: Planting, section 3.6 Sowing Depth.

## 4.3.2 Chemical damage

Herbicide and pesticide residues, and high rates of fertiliser at sowing can reduce the germination and emergence of crops.

For more information, see Section 2: Pre-planting – Safe rates of fertiliser at sowing.

Many herbicide labels place time and/or rainfall restrictions on sowing certain crops and pastures after application, due to potential seedling damage. Crops such as pulses and legume pastures are the most sensitive to herbicide residues. [13]

A real problem for growers is the difficulty in identifying herbicide residues before they cause a problem. Currently, growers are limited to predicting carryover based on information provided on the product labels about soil type and climate. Herbicide residues are often too small to be detected by chemical analysis, or if the testing is possible it is too expensive to be part of routine farming practice. Once the crop has emerged, diagnosis is difficult because the symptoms of residual herbicide damage can often be confused with and/or make the crop vulnerable to other stresses, such as nutrient deficiency or disease.

For more information, see Section 1: Planning and paddock preparation, section 1.6 Fallow Chemical plant-back effects or Section 6: Weed control, Potential herbicide damage section.

## 4.3.3 Stubble

Vetch is a more prostrate plant and benefits from being sown into stubble retention systems. This is common practice in the Northern region. Seedlings are able to germinate and emerge through stubble. The stubble can also slow aphid flight through the crop (acts as a physical barrier) and hence reduce insect damage and potential virus incursion from the aphid vector

One study aimed to determine the effects of stubble heights and positions on seed emergence of common vetch seed. Vetch was sown into two different stubble heights (short and long) and two different stubble positions (standing and flat). The best results of sowing performance and seed emergence were observed at the plots with short and standing stubble conditions. The emergence percentage decreased

11 CRDC. Comparative advantages/disadvantages of rotation crops with cotton. http://www.cottoninfo.com.au/sites/default/files/tools/CottonRotation/Rotation_chart_Page_1small.pdf

12 Day, T., Day, H., Hawthorne, W., Mayfield, A., McMurray, L., Rethus, G., & Turner, C. (2006). Grain legume handbook. *GRDC: Canberra, ACT*. https://grdc.com.au/__data/assets/pdf_file/0032/208886/chapter-3-seeding.pdf.pdf

13 RMS Agricultural consultants. (2016). Plant-back periods for fallow herbicides in Southern NSW. http://www.rmsag.com.au/2016/plant-back-periods-for-fallow-herbicides-in-southern-nsw/

with the increase in the stubble height (76.15% and 69.31% at 12 cm and 24 cm stubble heights, respectively). [14]

### 4.3.4 Damaged seed

A seed that has been damaged during harvest and handling, will produce an abnormal seedling –the shoot, the root, or both may be damaged. If the root is damaged the seedling will germinate, emerge and then generally die. This is because the taproot is weak and cannot grow normally. If the shoot is damaged the seedling will germinate and may emerge. Abnormal seedlings which do emerge lack vigour making them vulnerable to the rigours of field establishment. Factors such as temperature, disease, insects, seeding depth and soil crusting are more likely to affect the establishment of weak seedlings. Those that do emerge are unlikely to survive for long, producing little dry matter and making little or no contribution to final yield. [15]

## 4.4 Effect of temperature, photoperiod, climate effects on plant growth and physiology

### 4.4.1 Temperature and photoperiod

Vetch is adapted to Mediterranean and Temperate Zones of southern Australia (10-35°C). Low temperatures restrict winter growth. The optimum temperature range for growth is 23–15°C. [16]

The optimum temperature for *Vicia sp.* seed germination was identified to be between constant 15 and 20°C. These results agree with recommendations by International Seed Testing Association of germinating most *Vicia* seeds at 20°C. [17]

Temperature is one of the main environmental variables that determine time to flowering. Various forms of temperature summations, commonly referred to as heat units and expressed in 'growing degree-days' (GDD) or in 'thermal time' (Tt), have been widely used in studies to predict phenological events for crops.

The thermal time concept is based on the assumption that a fixed amount of heat units above a base temperature (Tb) or threshold temperature, below which no development takes place, is required to complete a specific development phase (Yin et al., 1996). Although temperature is the most important factor controlling the rate of plant development, other factors such as water and light availability and daylength (DL) may modify its effects. In Mediterranean-type climates (including some areas of southern NSW), photoperiod is considered to be an important environmental signal for flower initiation.

Photoperiodism or vernalization (response to light duration, light quality and radiant energy) is a mechanism that enables plants to respond to daylength so that they flower at a specific time of the year as determined by the length of the day. However, due to the effect of temperature, a plant will not always need the same amount of calendar time to develop to a certain developmental stage.

Flowering is considered the critical stage, because environmental conditions during the reproductive phase have a major impact on final yield and the onset of flowering often determines the entire crop duration. Equally important, from a practical point of view, flowering can be easily observed in the field. Therefore, being able to predict the time of flowering may be more important than any of the other phenological

14 Altikat, S., Celik, A., & Gozubuyuk, Z. (2013). Effects of various no-till seeders and stubble conditions on sowing performance and seed emergence of common vetch. *Soil and Tillage Research*, *126*, 72–77.

15 P Matthews, D Holding. (2005). Germination testing and seed rate calculation. NSW DPI. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/157442/pulse-point-20.pdf

16 CRDC. Comparative advantages/disadvantages of rotation crops with cotton. http://www.cottoninfo.com.au/sites/default/files/tools/CottonRotation/Rotation_chart_Page_1small.pdf

17 O Modisa (1999) Seed dormancy in vetch (Vicia species). University of Melbourne. https://minerva-access.unimelb.edu.au/handle/11343/114553

stages. Indeed, if flowering could be predicted, management decisions such as sowing date and harvest dates could be modified to maximise utilisation.

Studies on the phenology and optimal conditions for each phase of the crop cycle are essential in searching for the most suitable species and sowing times for particular regions. It has frequently been demonstrated that flowering time plasticity is a common adaptive feature of annuals, including legumes, in arid or semiarid environments. [18]

18 A Iannucci, M Terribile, P Martiniello (2008). Effects of temperature and photoperiod on flowering time of forage legumes in a Mediterranean environment. *Field Crops Research*, *106*(2), 156–162.