11. Faba beans and acid soils – making it work with lime and forward planning.

Helen Burns, NSW DPI Development Officer helen.burns@dpi.nsw.gov.au

KEY MESSAGES

- Faba bean and its specific Group F rhizobia are sensitive to pHCa below about 5.0
- Faba bean rooting depth is limited by acid layers in the soil profile
- Unincorporated, surface-applied lime increases pH of the soil surface, but has limited effect on subsurface pH in the short to medium term
- Lime incorporation to 10cm is necessary to rapidly increase subsurface pH
- Check for pH stratification before using Group B SU herbicides – elevated surface pH slows the breakdown of herbicide residue and may extend re-cropping intervals for legume species on acid soils to 22 months – check herbicide labels

Soil acidity and nodulation

Faba bean crops sown by farmers on acid soils in SA, Victoria and NSW were monitored in 2015 as part of a joint NSW DPI/Grains Research and Development Corporation project aimed at improving the performance of legumes in the Southern Region high rainfall zone. Crops at Frances and Kybybolite were overseen by the MacKillop Farm Management Group. Early results highlight the importance of liming and improving soil pH in the main root zone, particularly in the top 15cm.

The impact of acid soils on faba bean growth was similar across a range of soil types, from the loams of the Billabong Creek flats in NSW to the sandy loams of SA and south west VIC. The monitored crops fell into two clear categories: (i) vigorous, well-nodulated crops; and (ii) extremely variable crops, showing symptoms of nitrogen deficiency.

All crops were scored for nodulation in late winter / early spring and when these were checked against topsoil pH (0-10 cm) the connection between pH, nodulation and crop vigour was clear (Figure 1). In all cases soil tests for the crops with poor nodulation and vigour had a soil pH in calcium chloride (pHCa) below the recommended 5.2 for faba bean.

Analysis of the nodulation scores for faba bean crops and pH of 0–10 cm soil samples from the monitored paddocks showed a strong correlation (r2=0.89) between soil acidity and nodulation scores (0 = nil nodules present, to a maximum of 25 = all plants with effective nodules). This indicates that nodulation is affected by soil pH.

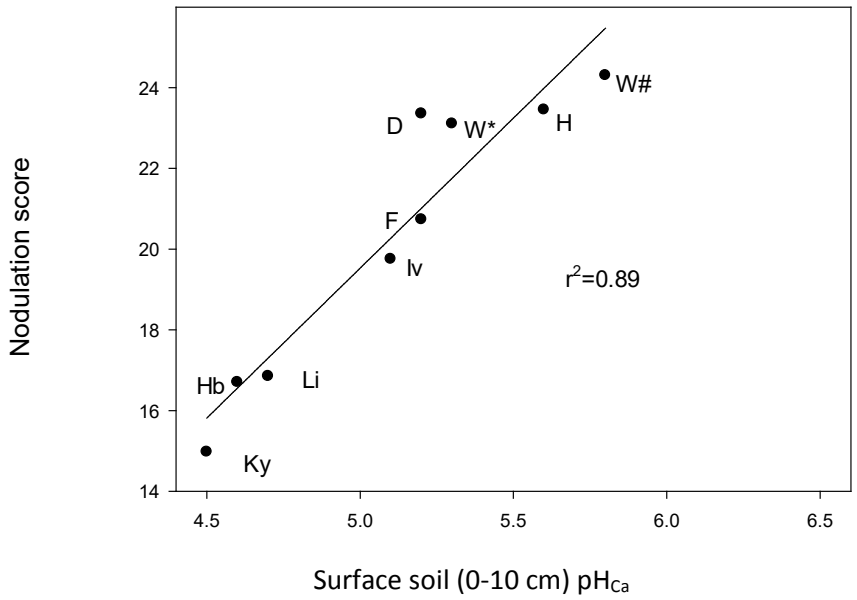

Figure 1. *The effect of topsoil pH (0-10cm) on nodulation of faba bean across the south eastern Australian high rainfall zone in 2015. Sites of sampling include Kybybolite, S.A. (Ky), Holbrook, NSW (Hb), Lismore, Vic (Li), Inverleigh, Vic (Iv), Frances, SA (F), Darlington, Vic (D), Willaura, Vic (W) and Henty, NSW (H). W* = after wheat, W# = after canola.*

Representative plants from the monitored paddocks, and several others with reported variable nodulation, were dug up to also check for root growth. As can be seen from the photographs of representative plants from the Kybybolite, SA (Figure 2) and Holbrook, NSW (Figure 3) sites, they were poorly nodulated and root growth was concentrated in the topsoil. The pH of the topsoil was tested at 5cm intervals and the results showed that at a sowing depth of about 4-5 cm faba bean seed and rhizobia were placed in an acid soil layer. This is likely to have affected rhizobia survival, root growth and therefore nodulation. The effect of soil acidity on survival of faba bean Group F rhizobia is critical to the yield potential of faba beans. These rhizobia are sensitive to pHCa below 5.0 – the optimal pHCa is above 6.0.

Figure 2. *Fully podded faba bean plants at Kybybolite, SA site sampled in late October were poorly nodulated and the roots did not grow below 10 cm in the unlimed soil. The pHCa reading for the from the 0-10 cm bulked sample tested in the laboratory was 4.5. The 0-5cm and 10 cm samples tested with a commercial field kit test gave a reading in the pHCa range of 3.8 – 4.3.*

Figure 3. *Faba bean roots of plants at early flowering at the Holbrook, NSW site in early September, were poorly nodulated with root growth restricted by the acid subsoil (4.2 pHCa at 10 cm), despite a history of 4t/ha of lime since 2009 (not incorporated).*

The vigorous, well-nodulated faba bean monitored crops were growing in paddocks with a long history of liming. This contrasted with poorly nodulated, variable crops that were sown into paddocks with either no lime (Figure 2) or recent applications of lime, which either had no incorporation or shallow incorporation with a speed tiller (Figure 3).

Standard soil testing procedures that use a bulked 0-10 cm soil sample may be misleading as unincorporated surface-applied lime moves very slowly into the subsurface layers. The pH stratification shown at the Lake Bolac and Holbrook sites (Table 2) is to be expected if lime is not incorporated to the recommended 10 cm. The lime is concentrated in the soil surface and while it has elevated the surface pH, there is limited effect on the subsurface pH.

Table 1. *The pHCa of samples taken from commercial monitor paddocks show that surface-applied lime has had limited effect on increasing subsurface pH.*

Depth (cm)	Lake Bolac, Victoria*		Holbrook, NSW**
	pHCa of soil from area of poor crop growth	pHCa of soil from area of good crop growth	pHCa – representative of paddock
0 - 2	5.3	7.8	6.9
5 - 7	3.8	4.8	4.9
12 - 14	3.8	4.3	4.3

*Lime surface-applied at 2.5t/ha in 2006 and 2013, not incorporated.
** Lime surface-applied at 2t/ha in 2010, plus 2t/ha in 2015 shallow incorporation with a speed tiller

Most growers have a minimum tillage farming program and rarely incorporate lime. If incorporation is not an option it is essential that lime is applied well before sowing sensitive species such as faba beans. The time for lime to impact on the subsurface layers will depend on soil type and rainfall. Growers should check for pH stratification of soils before sowing sensitive crops such as faba beans.

Be aware that surface-applied lime will also affect the breakdown of Group B sulfonyl urea (SU) residual herbicides. As shown in Table 1, liming may result in an alkaline surface layer, which, according to herbicide labels extends the re-cropping interval for legume species. For example the re-cropping interval for sulfonyl urea extends to 22 months when pHCa is above 5.8. It is therefore important to check re-cropping intervals on herbicide labels.

Growers have achieved high yields from faba beans, but these are not possible if nodulation and root growth is affected by subsurface acidity. The 2015 observations have highlighted the impact of acid soils on growth and yield potential of faba beans.

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