NSW GOVERNMENT Department of Primary Industries

Media Release

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

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

Key messages:

- Faba bean and its specific Group F rhizobia are sensitive to pH_{Ca} 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

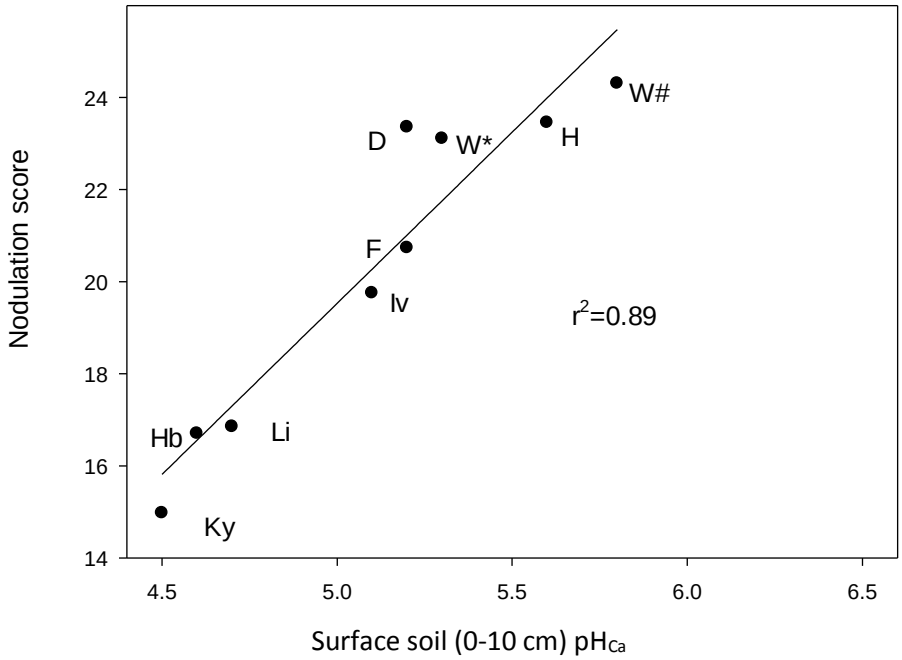
Faba bean crops sown by farmers on acid soils in SA, Victoria and NSW were monitored in 2015 as part of a joint NSW DPI/Grains Research and Development Corporation project aimed at improving the performance of legumes in the Southern Region high rainfall zone. Results from winter / spring crop inspections 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 monitor 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 (pH_{Ca}) below the recommended 5.2 for faba bean (Pulse Australia, 2015).

Analysis of the nodulation scores for faba bean crops and pH of 0–10 cm soil samples from the monitor paddocks showed a strong correlation (r^2=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 monitor 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 plants from Wickliffe, Vic (Figure 2) and the Holbrook, NSW site (Figure 3), 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 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 bean. These rhizobia are sensitive to pH_{Ca} below 5.0 – the optimal pH_{Ca} is above 6.0.

Figure 2. Fully podded faba bean plants at Wickliffe, VIC sampled in late October were poorly nodulated and the roots did not grow below 10 cm. Lime was applied in 2013 and not incorporated.

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 pH_{Ca} at 10 cm), despite a history of 4t/ha of lime since 2009 (shallow incorporation with speed tiller).

The vigorous, well-nodulated faba bean monitor crops were growing in paddocks with a history of liming and / or effective incorporation. The benefit of lime incorporation on root growth is evident in the Figure 4 which shows a Wickliffe crop from a paddock where lime had been incorporated in 2012 to a depth of 10 cm in order to control slugs. This contrasted with poorly nodulated, variable crops with either no lime or recent applications of lime, which either had no incorporated (Figure 2) or shallow incorporation with a speed tiller (Figure 3).

Figure 4. Fully podded faba bean plants from the paddock next to the crop in Figure 2. Lime had been applied in 2012 and incorporated to a depth of 10 cm. The crop was even, well-nodulated and the roots extended beyond 30 cm, into the moist subsoil.

Stratification of pH

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 Wickliffe and Holbrook sites (Table 2) is to be expected if lime is not incorporated to the recommended 10 cm. Unless it is incorporated the lime is concentrated in the soil surface and while it has elevated the surface pH, there is limited effect on the subsurface pH.

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

bean. The time for lime to impact on the subsurface layers will depend on soil type and rainfall. Growers should check for pH stratification before sowing sensitive crops such as faba bean.

Table 1. The pH_{Ca} of soil samples taken from commercial monitor paddocks show that surface-applied lime with limited icorporation has had limited effect on increasing subsurface pH compared with incorporation to 10 cm.

Depth (cm)	Wickliffe, Victoria			Holbrook, NSW#
	Lime not incorporated*		Lime incorporated to 10cm**	pH_{Ca} – representative of paddock
	Area of poor crop growth	Area of good crop growth		
0 – 2	5.3	7.3	6.8	6.5
5 – 7	3.8	4.8	5.3	4.9
12 – 14	3.8	4.3	4.8	4.3

*Lime surface-applied at 2.5t/ha in 2006 and 2013, not incorporated.
** Lime surface applied at 2.5t/ha in 2006 and 2012, not incorporated in 2006, incorporated to 10 cm in 2012.
# Lime surface-applied at 2t/ha in 2010, and 2t/ha in 2015 - shallow incorporation with a speed tiller.

Impact of soil pH on herbicide breakdown

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 pH_{Ca} is above 5.8. Check re-cropping intervals on herbicide labels!

Reference:
Pulse Australia, 2015 Southern Faba & Broad bean – Best Management Practices Training Course Manual

Acknowledgements:
Cooperating farmers in NSW, Victoria, South Australia and Tasmania

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