

# Phosphorus fertilisation of faba bean

## Approaches on low, medium and high P-soils



Sheila Alves, Kevin Murphy, John Carroll, Ivan Deverell, Mark Plunkett, David Wall and Michael Hennessy

Experiments in Ireland have shown that phosphorus (P) supply from the soil is important for high yielding faba bean crops. These observations are supported by studies showing that crops that fix nitrogen (biological nitrogen fixation, BNF) are particularly sensitive to P deficiencies. Phosphorus deficiency reduces nodule (which fixes nitrogen) growth and activity and impacts directly on crop growth. Irish research has also shown that in cases of limited available soil-P conditions, application of P fertiliser with the seed can improve crop development and increase yield. The purpose of this practice note is to provide insights into faba bean production practices arising from these findings.

### Outcome

Ensuring a good supply of nutrients, in particular phosphorus, from the soil is the nutritional foundation of high yield. Yield increases after P fertilisation of up to 40% are reported under

### Applicability

**Theme:** Crop nutrition

**For:** All faba bean growers

**Where:** On all farms where faba bean is grown, in particular in low soil-P index sites

**Timing:** Pre-sowing, at sowing and/or after sowing

**Equipment:** Direct drill, plough, spreader, combine drill

**Follow-up:** No follow-up action required

**Impact:** Maximise yield

farm conditions in low P index soils. Good fertilisation practice secures this yield potential while minimising the risk of phosphorus loss to water. Placement of P close to the seed in low P soils supports good P utilisation and ensures optimum use of the investment in fertiliser.



Faba bean. Photograph: Thorsten Haase (LLH)

**Table 1.** Soil phosphorus (P) indices and corresponding P application rates recommended for faba bean in Ireland.

Soil index	Response of crop to fertilisers	Soil test P (mg/l, Morgan extraction)	P application rate (kg/ha)
1	Definite	0 – 3.0	50
2	Likely	3.1 – 6.0	40
3	Unlikely	6.1 – 10.0	20
4	None	> 10.0	None

Source: Teagasc, 2020

### Rate of phosphorous application

The above reported evidence on phosphorus supply being particularly important for high yielding faba bean crops grown under low soil-P supply has important implications for production practice in Ireland and in other countries. Faba bean yielding above 6.5 t/ha is common in Ireland. What are the implications for practice and what are the principles that determine these practices?

Soil analysis for plant available P is the basis of planning phosphorus applications to all crops. This involves laboratory analysis of representative soil samples following national or regional guidelines.

The Irish soil index system categorises soils into one of four soil index levels based on the soil test P result (Morgan extraction). Table 1 shows the P recommendation for each soil index for faba bean.

### Soil pH and phosphorous uptake

Phosphorus exists in several different forms in soil and the occurrence of each of them depends largely on soil pH. Plant available inorganic P is most abundant when the pH is between 6 and 7. A whole-farm liming regime that maintains soil pH between 6.5 and 7 over the rotation ensures that the soil phosphorus is most available to crops.

### Application time and method

Beans as with other legume crops require P for crop growth, from early development to the end of grain fill. Plants require relatively small amounts of P during establishment but have high P uptake during rapid canopy development. Ensuring the availability of P at the establishment phase is essential. This can be from soil reserves or applied P in low P sites.

Phosphorus is relatively immobile in soil and so applications on low index soils must be made at or before sowing to influence plant growth. Placement of fertiliser in close proximity to the seed (either by placement in the same furrow as the seed or by side banding at planting/seeding) is an effective method of fertiliser application, especially to provide a starter source of nutrient for early crop nutrition and growth.

Depending on the soil P status, fertiliser may be broadcast (ideal for higher P sites), with or without subsequent incorporation, or placed close to the seed at planting (which is beneficial on low P sites). Where soil phosphorus levels are adequate, faba bean shows little response to timing and method of application.

Where P requirement is high, placing all the P with the seed at sowing may increase the risks of damaging the emerging plant. Incorporation/ placement of P at sowing provides a good basis for high yields, especially in low P-soils.

**Table 2.** Recommendations in Ireland for P-application method and timing.

Soil index	Timing	Method
1	With sowing	Combined drilling the recommended P-application at sowing time to increase crop vigour, pod number and overall bean yield. If using split applications of P, the final P can be broadcast after crop emergence.
2	Before or after sowing	Broadcast

Source: Teagasc, 2020

### Key practice points

- Research observations indicate that faba bean is responsive to good P fertilisation due to the effect of phosphorus on nodule formation and function. This impacts indirectly on the nitrogen supply from biological nitrogen fixation.
- As a pre-requisite for the effective application of P fertilisers, soil samples must be taken and analysed according to national or regional standard practices to determine the soil phosphorus levels/indices following national guidelines.
- Application methods should take into account soil phosphorus index and the rate of phosphorus to be applied. Placement of P close to seed is important on low P index soils. This is achieved using combined drilling where the fertiliser is placed in or beside the seed row. On high P index soils, placement close to the seed is less important and broadcasting before or after sowing can be used.

### Further information

Watson, C. A., Reckling, M., Preissel, S., Bachinger, J., Bergkvist, G., Kuhlman, T., Lindström, K., Nemecek, T., Cairistiona F. E. Topp, C. F. E., Vanhatalo, A., Zander, P., Murphy-Bokern, D. and Stoddard, F. L., 2017. Chapter Four - Grain legume production and use in European agricultural systems. Editor(s): Sparks, D. L. *Advances in Agronomy*, Volume 144, 235–303 <https://doi.org/10.1016/bs.agron.2017.03.003>

Grant, C. A., Flaten, D. N., Tomasiewicz, D. J. and Sheppard, S. C., 2001. The importance of early season phosphorus nutrition. *Can. J. Plant Sci.* 81(2): 211–224.

Havlin, J. L., Beaton, J. D., Tisdale, S. L. and Nelson, W. L., 2014. *Soil Fertility and Fertilizers. An introduction to nutrient management.* 6<sup>th</sup> ed. Prentice Hall, NJ.

Henry, J. L., Slinkard, A. E. and Hogg, T. J., 1995. The effect of phosphorus fertilizer on establishment, yield and quality of pea, lentil and faba bean. *Can. J. Plant Sci.* 75: 395–398.

The Fertilizer Association of Ireland in association with Teagasc, 2019. The efficient use of phosphorus in agricultural soils. Technical Bulletin Series – No. 4, February 2019 (Booklet). <https://www.fertilizer-assoc.ie/wp-content/uploads/2019/02/The-Efficient-Use-of-Phosphorus-In-Agricultural-Soils-Tech-Bulletin-No.-4.pdf>

The Fertilizer Association of Ireland in association with Teagasc, 2017. Precise application of fertiliser. Technical Bulletin Series – No. 3, May 2017. <https://www.teagasc.ie/publications/2017/precise-application-of-fertiliser.php>

The Fertilizer Association of Ireland in association with Teagasc, 2015. Soil Sampling - Why & How? Technical Bulletin Series – No. 1, October 2015. <https://www.fertilizer-assoc.ie/wp-content/uploads/2015/10/Fert-Assoc-Tech-Bulletin-No.-1-Soil-Sampling.pdf>

## Sources

Carroll, J. and Deverell, I., 2016. Bean production and agronomy. National Tillage Conference, 28 January, 2016. [www.teagasc.ie/media/website/publications/2016/Tillage-Conference-Proceedings-2016.pdf](http://www.teagasc.ie/media/website/publications/2016/Tillage-Conference-Proceedings-2016.pdf)

Divito, G. A., Sadras, V. O., 2014. How do phosphorus, potassium and sulphur affect plant growth and biological nitrogen fixation in crop and pasture legumes? A meta-analysis. *Field Crop Research*. 156, 161–171.

Sanz-Saez, A., Morales, F., Arrese-Igor, C. and Aranjuelo, I., 2017. P deficiency: A major limiting factor for rhizobial symbiosis in legume nitrogen fixation in soils with low phosphorus availability: adaptation and regulatory implication. Edited by Sulieman, S. and Tran, L. S. P. Springer International Publishing, CY, pages 21–39.

Teagasc & Irish Farmers Journal, 2017. *Crops & Cultivation*. Oak Park, Carlow, Teagasc. [www.teagasc.ie/publications/2017/crops-and-cultivation-2017.php](http://www.teagasc.ie/publications/2017/crops-and-cultivation-2017.php)

Teagasc, 2020. Major & micro nutrient advice for productive agricultural crops, 5th edition. Teagasc, Johnstown Castle, Environmental Research Centre, Co. Wexford. Edited by Wall, D. P. and Plunkett, M. [www.teagasc.ie/media/website/publications/2020/Major--Micro-Nutrient-Advice-for-Productive-Agricultural-Crops-2020.pdf](http://www.teagasc.ie/media/website/publications/2020/Major--Micro-Nutrient-Advice-for-Productive-Agricultural-Crops-2020.pdf)

## About this practice note and Legumes Translated

**Authors:** Sheila Alves, Kevin Murphy, John Carroll, Ivan Deverell, Mark Plunkett, David Wall and Michael Hennessy

**Publisher:** Teagasc

**Production:** Donau Soja

**Permalink:** [www.zenodo.org/record/4926384](http://www.zenodo.org/record/4926384)

**Copyright:** © The Authors, 2021. Reproduction and dissemination is permitted for non-commercial purposes provided the authors and source are fully acknowledged.

This practice note was prepared within the Legumes Translated project funded by the European Union through Horizon 2020, Project Grant Number 817634.

**Citation:** Alves S., Murphy K., Carroll J., Deverell I., Plunkett M., Wall D. and Hennessy M., 2021. Phosphorus fertilisation of faba bean. *Legumes Translated Practice Note 29*. Teagasc. [www.legumestranslated.eu](http://www.legumestranslated.eu)

The content is solely the responsibility of the authors. No warranties, expressed or implied, are made with respect to the information provided. Information relating to the use of plant protection products (pesticides) must be checked against the product label or other sources of product registration information.



This project is funded  
by the European Union

