Grower Summary

FV 380

Identification of critical soil P in vining pea crops.

Annual 2011

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Further information

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Project Number:	FV 380
Project Title:	Identification of critical soil P in vining pea crops.
Project Leader:	Nathan Morris
Contractor:	The Arable Group (NIAB-TAG)
Industry Representative:	Richard Fitzpatrick, Holbeach Marsh Cooperative
Report:	Annual report, June 2011
Publication Date:	16 September 2011
Previous report/(s):	None
Start Date:	July 2010
End Date:	Dec 2014
Project Cost:	£116,862

Headline

This project aims to identify the levels of Phosphate required in vining pea production to help growers maximise yield and quality.

Background

The British Survey of Fertiliser Practice shows that there has been an overall decline in phosphate (P) use on crops from 56 kg/ha P_2O_5 in 1983-87 to 34 kg/ha in 2004-08. Over recent seasons the long term price trend for P fertiliser has continued to rise. While there have been some recent fluctuations in P cost, price shifts for the 15 months running up to April 2008 saw world di-ammonium phosphate price rise by around 400%.

Where P is not applied, crop off take (e.g. 8-10 kg/ha P_2O_5 for vining pea crops) is leading to a gradual decline in soil P reserves. RB209 (edition 8) guidance on phosphate levels for vining pea crops suggests that P is required at more than maintenance where soil levels are less than Index 2. This can be expensive to the grower; for example at soil Index 1 or below, a dose of between 60 and 85 kg/ha of P_2O_5 is often suggested for vining pea crops, this dose could cost around £75/ha based on spring 2011 prices.

Many growers are questioning whether or not a target soil P Index of 2 (Olsen P range of 16-25 mg/l) is appropriate for all soil types and crop conditions. This target Index, based on critical soil P levels to achieve 95% of maximum crop yield, was established to achieve economic yields for all crops grown in any rotation and was based on the results of a limited number of field experiments. Although for a given Olsen P value the crop availability of P per unit volume of soil should be the same regardless of the crop and soil type (except perhaps on acid soils or for permanent grassland receiving water-insoluble P), critical P values can vary between soils, depending upon soil physical conditions (*e.g.* soil structure, moisture, bulk density, stone content and soil porosity) and between crops, depending on root growth and architecture and P uptake rate needed to achieve maximum yield. To date, however, sufficient data for making a scientifically robust change to the recommendations have not been available.

High soil P levels increase the risk of P transfer to surface waters leading to the undesirable effects of eutrophication; annual losses of P of as little as 2 kg/ha, whilst of no economic significance to the grower, can be associated with an increased eutrophication risk. In Ireland (Agri-Food and Biosciences Institute, 2002 and Environmental Protection Agency, 2011) phosphates have been found in high concentrations in surface waters; this has resulted in legislation being introduced under the Water Quality Standards for Phosphorus

Regulations, 1998. Further monitoring of water quality under the Water Framework Directive (WFD) is likely to become of increasing importance within England and put further pressure on growers to validate P fertiliser use.

The P levels suggested for vining pea production are based on long-standing data and perceptions that have not been validated in the context of modern production techniques / varieties, environmental influences and current costs. The objective of this project is to provide agronomic validation of P requirements, help growers to maximise yield and quality and also potentially offer useful savings.

Summary of the project and main conclusions

Site design and selection

Experimental design is based on a randomised block design involving seven treatments with two replicates (see Appendix A for trial plan), on relatively large plot areas, as plots will need to remain in place and be easily locatable for the following vining pea crop. Data will be analysed across seasons both within and across soil types to allow for cross-trial analysis.

The field experiments will focus specifically on vining pea crops; 3 experiments will be carried out on each of 3 soil types across a staggered 4 year trialling sequence (a total of 9 experiments) as detailed below.

Table 1: Proposed staggered experimental design.

	2010/11 (Year 1)	**2011/12 (Year 2)**	**2012/13 (Year 3)**	**2014 (Year 4)**
Experiment 1	Cereal	Vining peas	-	-
Experiment 2	-	Cereal	Vining peas	-
Experiment 3	-	-	Cereal	Vining peas

Soil types may include a loamy sand, sandy loam and silty clay loam. For each of the experimental locations, a series of sites destined for vining pea production (covering the desired set of soil types) will be sought. These sites will have a low inherent P index (with the majority at an Index 1 or lower) i.e. sites that would normally receive a substantial P dose ahead of a vining P crop. At each site a preceding crop (*e.g.* possibly a cereal crop) will be established and managed by the host farmer. A trial area will be established within the cereal crop that will be used as a canvas on which to create a range of Olsen P levels, on large plot areas, ranging from 0 mg/kg to 24 mg/kg above the lowest value at each site. Information being made available through the existing HGCA project (HGCA, 2009) will facilitate the attainment of this range of soil P levels by applying appropriate amounts of triple superphosphate. At each site soil texture, stone content and soil organic matter will be

determined to aid interpretation. The soil will also be analysed to ensure no other major nutrient deficiencies are present.

Soil sampling

Each of the 14 large plots were individually sampled, to the intended cultivation depth (15, 20 or 25cm), using a gouge auger or similar.

Sixteen cores per large plot area were sampled randomly from the whole of that plot. From each plot the soil cores were bulked and mixed thoroughly, cutting any lumps into small pieces and removing any vegetation, other extraneous material and as many stones as possible. A sub-sample of c. 1kg from each plot was sealed in a plastic bag, labelled with the project title, site name, plot/rep number, and sampling date and sent to a laboratory for analyses.

Fertiliser application

Large plots that receive one of five different P fertiliser doses were established prior to the preceding crop of the field experiments, in order to raise soil Olsen P levels by different amounts to create a range of 'stabilised' P values prior to sowing the vining pea crop. Further large plots will receive one of two different P fertiliser doses prior to the vining pea crop, in order to raise soil Olsen P levels by different amounts and create a range of 'fresh' P values. Required doses of P fertiliser were calculated for specific treatments, as shown in Table 2, to take account of soil type, stone content and cultivation depth (this will take advantage of methods already being utilised in the analogous HGCA project; research at Rothamsted has shown how much fresh P fertiliser is needed to increase Olsen P by 1 mg/l). Treatments were arranged in two replicates of seven treatments, as there will be two untreated treatments in each replicate. This will give 14 large plots in total.

Table 2: Treatment list.

Treatments	P status	Olsen P (mg/l)
Treatment 1a	Untreated a	Untreated
Treatment 1b	Untreated b	Untreated
Treatment 2	Stabilised	3
Treatment 3	Stabilised	6
Treatment 4	Stabilised	9
Treatment 5	Fresh	3
Treatment 6	Fresh	9

For each experiment, P will either be applied ahead of the preceding (cereal) crop and

allowed to 'stabilise' for around 18 months or will be applied as a 'fresh' dose immediately ahead of the vining pea crop. To ensure that doses of P are sufficiently incorporated into the soil specific treatments large doses will be split 50:50 prior to primary cultivations and prior to drilling operations.

The application of triple super phosphate (TSP) fertiliser was applied to the 12m wide large plots using a 12m wide pneumatic spreader, calibrated to deliver the required dose, or using a purpose built plot spreader.

Site locations

Year 1
Three experimental sites were found in 2010/11 (year 1) on a range of soil types as described in Table 3. Currently these sites are in the preceding crop prior to vining peas with the 'stabilised' P doses applied to the plots and awaiting the application of 'fresh' doses immediately ahead of the vining pea crop.

Table 3: Site details for vining peas in 2012.

Location	Soil type	Soil series	Cultivation and depth	Crop harvest 2011
Brocklesby, Lincs	Sandy loam	Landbeach	Non-inversion (20cm)	Winter wheat
Ingoldisthorpe, Norfolk	Loamy sand (over chalk)	Newmarket 2	Plough (25cm)	Winter Barley
Docking, Norfolk	Sandy loam	Barrow	Plough (25cm)	Sugar beet

The soil sampling was completed (as specified above) with each site attaining a range of Olsen P values as shown in Figure 1 below. The application of varying doses of TSP fertiliser has created a range of Olsen P levels, on large plot areas, expected to range from 0 mg/kg to 24 mg/kg above the lowest value at each site as shown in Figure 2.

Currently two of these sites are on schedule and will be due to enter vining pea cropping in spring 2012. However, it is currently anticipated that the third site (at Ingoldisthorpe) is unlikely to be growing vining peas in 2012 due to a change in farm circumstances. Attempts are being made to mitigate the effects of this in subsequent years following a discussion at a review meeting on the 10th February 2011.

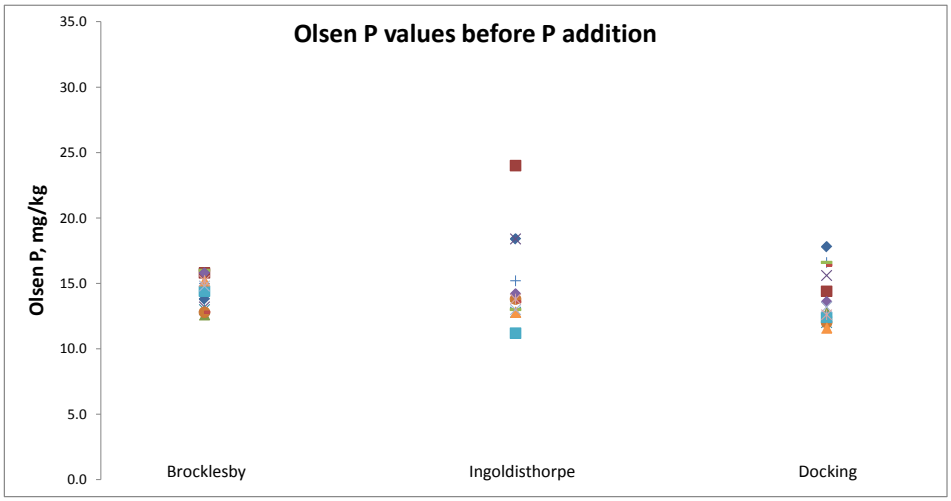

Figure 1: Olsen P values attained at each site in Year 1 (2010/11) prior to P fertiliser addition.

Note: individual coloured points represented separate plots

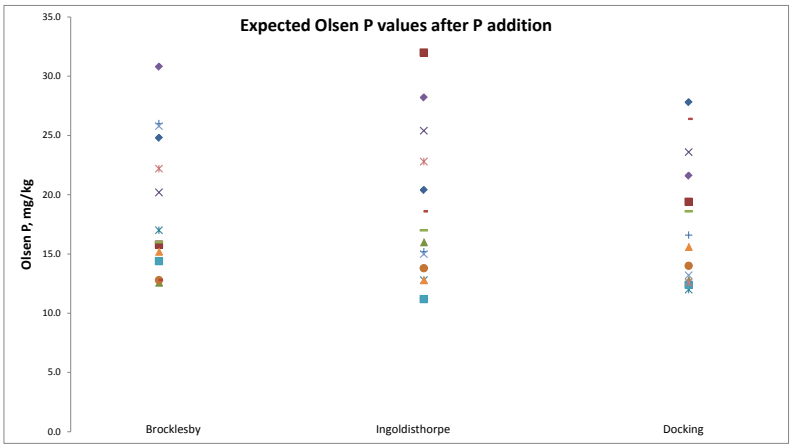

Figure 2: Expected Olsen P values attained at each site in Year 1 (2010/11) following P fertiliser addition.

Note: individual coloured points represented separate plots

Year 2

Site selection for a further three experimental locations for vining peas in 2013 are currently being secured and a provisional list of sites is shown in Table 4.

Table 4: Provisional site details for vining peas in 2013.

Location	Soil type	Soil series	Cultivation and depth	Crop harvest 2012
Louth, Lincs	Silty clay loam (over chalk)	Andover 1	Non-inversion (20cm)	W Barley
Docking, Norfolk (tbc)	tbc	tbc	tbc	tbc
Norfolk or Lincs. (tbc)	tbc	tbc	tbc	tbc

Future crop assessments

During the years in which cereal crops will be grown it is intended that these will not be harvested as part of the project. Vining peas will be grown following the preceding (cereal) crop. During the season specific observations in the vining pea crop relating to P nutritional status will be assessed, with parameters likely to include, crop height, crop vigour and an assessment for root nodulation. The plots will then be used to determine the yield and quality response of the vining peas grown on 'stabilised' P index soils or in response to 'fresh' applied P; responses in these situations will be used to ascertain critical P levels. It is envisaged that experimental plots will either be harvested on a single day (to coincide with the harvest date of the grower) although soil P deficiency may alter crop maturity and therefore a sequential harvest lift will take place on some sites to assess for relative crop maturity. Following harvest specific sensory evaluation assessments will include both flavour and texture to ensure that quality specifications are met.

Main conclusions

Due to the stage at which the project is up to there are currently no results detailing critical phosphate levels in vining peas. Preliminary results from the first year indicating the response to critical phosphate in vining peas will be available after autumn 2012.

Knowledge and Technology Transfer

Recent knowledge transfer activities have included a series of articles in the following publications highlighting the background to this project:

- HDC News March 2011 No. 171

- NIAB TAG Landmark Bulletin May 2011 Issue 6

A short presentation on the background to this project was presented at the PGRO Vining Pea Trials Day at Thornhaugh, Peterborough on 8th June 2011.

Action points for growers

- There are no action points for growers at this early stage of the project.