

Diagnosing P and K requirements of winter wheat

Topic Sheet No. 19
Winter 1998/99



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Background

Phosphorus (P) and potassium (K) recommendations for cereals are based on soil analysis but little is known about critical soil values for maximum yield on different soils. Most soils are unlikely to be responsive to P and K. Farmers need reliable methods for matching crop needs with soil supply to protect yields, profits and the environment. LINK-funded research (HGCA and MAFF) has investigated the use of plant tests for winter wheat. Combined soil and plant tests should help farmers improve P and K management.

Soil tests

Standardised chemical extraction procedures, Olsen-P and exchangeable-K, are used to rank soils according to available P and K to plants. Values are grouped into ten indices from deficient (0) to excess (9). Fertiliser trials have led to the following generalisations: yield responses are probable at Index 0, possible at Index 1 and unlikely at Index 2 and above. Index 2 starts at 16 ppm for P and 121 ppm for K. Soil tests can be carried out before sowing and remedial dressings applied if

needed (see *Fertiliser Recommendations* MAFF Reference Book 209). Most UK arable soils have ample P and K supplies.

Yield losses can be large if soils are very deficient (Figure 1). Critical soil values for maximum yield, and response to fertiliser, depend on soil type (composition and structure) but these are not known for most soils. Soil tests also take no account of subsoil nutrients. Even Index 0 soils may not respond to K if there are sufficient subsoil reserves.

Plant tests

Visible deficiency symptoms indicate extreme soil deficiency. Plant tests can confirm if soil P and K are adequate for crop needs regardless of soil type, particularly in the Index 1-2 range. Plant tests can be carried out on a "wet" or "dry" matter basis. Wet tests are carried out on extracted plant sap.

Figure 1. Yield response of winter wheat to available P and K on a silty clay loam soil

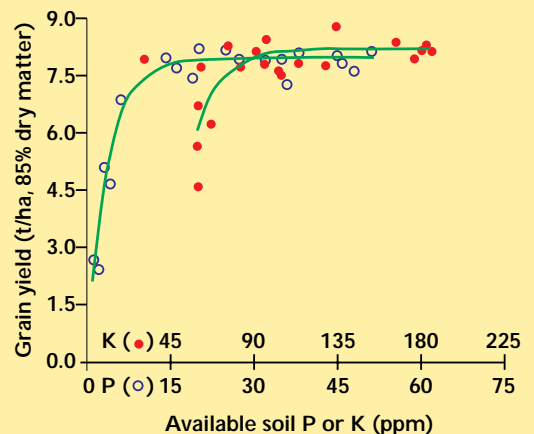


Table 1. Leaf PK tests: critical concentrations for winter wheat

Test	Mean	Range
“Dry” tests (laboratory)		
Total P in leaf(1)	0.32%	0.28 - 0.38%
Total K in leaf(1)	1.9%	1.6 - 2.5%
“Wet” tests (on-farm)		
Total K in leaf(1)	150 mM	130 - 170 mM

Range covers the variation in critical values observed between crops during the project.

Timing of plant tests

Plant tests are best done during stem elongation (GS 31-39). If there is a deficiency, remedial action can be taken for the next crop. If soil test values are

Three plant tests are available:

- **Shoot tests** are based on total P and K in shoot dry matter. The tests require laboratory facilities. The results are difficult to interpret as critical values depend on crop growth stage and growing conditions.
- **Leaf tests** are based on total P and K in the newest fully expanded leaf blade (leaf(1)). They can be carried out on a dry matter basis in the laboratory, or for K only, on a wet matter basis on-farm (Table 1).
- **Stored P** tests measure orthophosphate which is stored in shoots when P is over-supplied and can be done either wet or dry (Table 2).

above Index 2 or plant test values are above the maximum figures in the ranges shown in Tables 1 and 2, there is scope to withhold inputs in the short-term.

Wider applications

Plant tests based on stored P and wet K are physiologically sound and critical values should apply to other wheat varieties and other cereals.

Test kits for analysing stored P and K in plant sap, as well as other nutrients, are available commercially. Protocols for plant sampling, extracting and analysing sap, and interpreting results are currently being developed.

Table 2. Stored P tests: critical concentrations for winter wheat

Test	Mean	Range
“Dry” test (laboratory)		
Stored P in shoots	0.06%	0.05 - 0.07%
“Wet” tests (on-farm)		
Stored P in shoots	5 mM	4 - 6 mM

Range covers the variation in critical values observed between crops during the project.

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Action:

- **Test soils periodically (every four years) for available P and K.**
- **Take soil samples before cultivating if a deficiency is suspected.**
- **Base fertiliser applications on soil test results if these are unequivocal (consult MAFF Reference Book 209).**
- **If soil test results are “border-line” or there are other doubts carry out plant tests at stem elongation.**
- **Use leaf or stored P tests.**

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