



Tissue testing for phosphorus

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Summary

Discusses role of tissue testing for phosphorus in annual plants, including timing of fertiliser application. Table presents critical phosphorus levels in cereals, lupins and pasture legumes at different stages of growth.

Introduction

The concentration of phosphorus (P) in plant tissue is used to provide an estimate, at the time of sampling, of the current phosphorus status of annual plants. This is called a *diagnostic* tissues test for phosphorus.

Tissue testing for phosphorus is also sometimes used to *predict* future plant production. That is, a tissue test at an early growth stage is used to predict grain production of crops at the end of that growing season or pasture dry matter production for growing silage and hay in spring of that year. This is called a *prognostic* tissue test for phosphorus. However, if the test indicates phosphorus is deficient and likely to reduce grain or pasture yields later on in the years, then applying fertiliser phosphorus to that crop or pasture is unlikely to produce profitable responses later on that year unless the fertiliser is applied in early growth (drilled with the seed or topdressed to pasture soon after pasture emergence near the start of the growing season). Tissue testing for phosphorus is like soil testing for phosphorus; both indicate the need for fertiliser near the start of the next growing season.

Methods of tissue testing

The simplest and most widely used procedure is to use whole tops of plants, or parts of whole tops, and seed or grain produced at the end of the growing season.

Whole tops are collected for crop species by selecting individual plants at random and cutting off whole plants at ground level.

Parts of whole tops are collected for pasture by collecting random samples of top growth. These samples are collected from near the tops of the pasture plants and include most of the youngest (newly-grown) herbage grazed by animals. Seed is collected at the end of the year by collecting random samples of seed in burrs, pods or heads.

The plant tissues collected for the phosphorus tests are dried and then ground before being dissolved in

strong acid to produce a solution called the digest. The phosphorus concentration in the digest is measured to provide tissue test values. The test values are usually expressed as percentage phosphorus in the dried tissue.

Critical phosphorus concentrations in plant tissue

In tissue testing, plant production (y-axis) is related to tissue test values as the x-axis. For this relationship the phosphorus concentration in the plant tissue that produces 90 per cent of the maximum yield is defined as the critical phosphorus concentration. The critical value is when 10 per cent of the maximum yield is lost due to phosphorus deficiency in the plant tissue. Therefore, tissue test values below the critical value are highly likely to be phosphorus deficient for shoot or grain production. This requires that the relationship between yield and tissue test value is well defined, including an accurate measure of the maximum yield. It is also essential that no other factors limit plant yield. Such factors include deficiencies in other elements, diseases or pests, soil acidification and soil compaction.

Role of tissue testing

Phosphorus is needed by plants as soon as the embryo in the seed starts to germinate and grow. Any deficiency during early plant growth greatly reduces future plant yields. It is usually too late to apply fertiliser phosphorus 10 to 14 days after emergence of crops and pastures, and any yield response to late applications is generally small and not profitable. By the time results of tissue analysis are obtained, it is too late to correct phosphorus deficiency that year. The deficiency is corrected by applying phosphorus fertiliser at the start of the next growing season. A soil test for phosphorus is recommended to confirm phosphorus deficiencies indicated by the tissue test.

Tissue tests for phosphorus can provide a very useful guide as to whether plants are:

- acutely deficient in phosphorus, or
- possess luxury levels of phosphorus.

This suggests either gross deficiency or an abundant supply of phosphorus in the soil.

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However, in the responsive region of the relationship between yield and phosphorus tissue test values, tissue testing for phosphorus can only provide a rough guide for the phosphorus status of plants. For diagnostic and prognostic purposes, the relationship between yield and phosphorus concentration in tissue is affected by many non-nutritional factors and interactions.

- It differs between sampling times during the growth of the plant in any one year and also between years.

- It differs between plant species.
- It differs between environments and soils.

Table 1 provides a guide to phosphorus levels in crops and pastures at different stages of growth.

For details of sampling tissues, arranging for tests and for interpretation of tissue tests, consult your local Department of Agriculture and Food office or an adviser, or your consultant.

Table 1. Critical phosphorus concentration

Plant species	Range for critical phosphorus concentration values in plant tissue (%)		
	Dried whole tops		
	70 to 90 days after sowing	Up to flowering	Seed
Cereals and lupins†	0.40 to 0.60	0.25 to 0.35	0.25 to 0.30
Pasture legumes*	0.40 to 0.80	0.30 to 0.40	0.70 to 0.90

† Cereals are wheat, barley, oats and triticale.
Lupins are narrow-leaved lupins.
* Pasture legumes are subterranean clover, annual medics and yellow serradella.