No. 95
July 1996

# SEASONAL CHANGES IN SOIL AVAILABLE PHOSPHORUS CONCENTRATIONS

**A. G. Cameron, Principal Pastures Agronomist**

**Summary**

Soil available phosphorus levels increased during the wet season and then decreased during the following dry season.

A soil sample taken during the dry season will not accurately predict the amount of phosphorus available to pasture legumes during the subsequent wet season.

**Introduction**

In 1986 during research on the fertility of yellow earth soils in the Douglas Daly area, soil samples taken during the dry season were low in available phosphorus, all being less than 5 ppm. This was following the 4th (Verano, *Stylosanthes hamata)* or 2nd (Cavalcade, *Centrosema pascuorum*) year of trials where up to 80 kg of P had been applied.

There had been a good response to applied phosphorus by the two legumes during the 1985/86 wet season, and again during the 1986/87 wet season at the two sites which continued.

The results suggested that either the test for available phosphorus was not adequate or that the availability of phosphorus differed between the wet and dry seasons.

This study was conducted to determine if the available soil phosphorus changed during the wet and dry seasons.

**Method**

The area used for the study was a trial area on a Hotham red earth soil at Berrimah Farm (BF, 12 26'S, 13 52'E, AAR 1 700 mm) used for a *Macroptilium gracile* trial (Cameron and Ross 1994)

The paddock had a long history of cropping with considerable amounts of superphosphate applied, including 200 kg/ha superphosphate in January 1986. Soil from the bare laneways of the *M. gracile* trial area were sampled at monthly intervals between 27 November 1986 and 23 March 1987, then again in late May and early August 1987. On each occasion the laneways were sampled by collecting 20 0-10 cm cores of soil. These cores were bulked, air-dried and submitted to Chemistry Section of DPIF for analysis for conductivity, pH and available P, K, S and Zn.

**Results**


ISSN 0158-2755

Rainfall for the 1986/87 wet season (Sept-June) totalled 1 670 mm, which was close to the average. Sixty percent of the rain fell in January and February.

The results of the soil analyses are presented in Table 1.

Table 1: Soil analysis from *Macroptilium gracile* area 1986/1987

| Date | Cond mg/cm | pH | P ppm | K ppm | S ppm | Zn ppm |
|---|---|---|---|---|---|---|
| 27/11/86 | 0.10 | 5.1 | 29 | 77 | 35 | 1.6 |
| 24/12/86 | 0.11 | 4.9 | 26 | 81 | 28 | 1.1 |
| 27/01/87 | 0.02 | 5.3 | 42 | 62 | 40 | - |
| 27/02/87 | 0.03 | 5.4 | 40 | 59 | 28 | 1.7 |
| 23/03/87 | 0.05 | 5.0 | 48 | 59 | 18 | 2.1 |
| 27/05/87 | 0.06 | 4.9 | 54 | 62 | 17 | 1.8 |
| 06/08/87 | 0.06 | 5.1 | 38 | 60 | 29 | 1.2 |

Availabe P increased from 29 ppm in late November up to 54 ppm in May, and dropped back to 38 ppm in August. This is illustrated in Figure 1 where soil available P and half monthly rainfall are plotted against time.

Of the other soil factors, pH increased to a high of 5.4 in February, then declined, K and S declined, although S increased between May and August and Zn appeared to remain constant over the trial period.

**Discussion**

There was a marked increase in soil available P levels during the wet season which declined rapidly following the cessation of the rain in May.

Seasonal variation in soil available phosphorus has been recorded from a number of studies (Childs and Jencks 1967, Friesen *et al* 1985, Jessop *et al* 1977, Kemp *et al* 1985, Sorn-Srivichai *et al* 1988). The reasons advanced for the seasonal fluctuations include pasture P uptake (Sorn-Srivichai 1988) which does not apply in this case and climate through moisture and temperature.(Kemp *et al* 1985, Jessop *et al* 1977, Childs and Jenks 1967), while Friesen *et al* (1985) could not establish any consistent association with soil moisture index (SMI) or soil temperature. The lack of association by Friesen *et al* (1985) may be related to the fact that they attempted to establish a relationship with the SMI and temperature at the time of the soil sampling.

An examination of Figure 1 suggests that the increase in soil available P lags behind the rainfall. This is supported by Jessop *et al* (1977) where an increase in phosphorus at two samplings followed high rainfall in the previous two sampling periods. Childs and Jenks (1967) suggested that an increase in available phosphorus in one month and a decrease in the next may have been related to the effects of temperature and rainfall in the preceding months.

The reason for the increase is not known. It may be from increased availability from waterlogging as reported by Bradley *et al* (1984) and Choudbury (1986), increased mineralisation of soil organic P, or a combination of both. The rapid drop in available level on drying suggests that the availability is related to wetting and drying. The same process may be operating in the yellow earth soils of the Douglas Daly area where legume responses in fertiliser trials are greater than dry season soil P levels would suggest they should be.

On these soils, a sample taken for soil analysis will underestimate the amount of P available to plants during the subsequent wet season.

**Conclusion**

The available soil phosphorus levels showed seasonal fluctuations, with levels increasing during the wet season and decreasing when rainfall ceased.

References

References


Bradley J., Vimpany I. and Nicholls P.J. (1984). Effects of Waterlogging and subsequent drainage of a pasture soil on phosphate sorption, extractable phosphate and oxolate-extractable iron. Aust. J. Soil Res. **22**: 455-61.

Cameron A.G. and Ross B.J. (1994). Evaluation of *Macroptilium longepedunculatum* (Maldonado) lines near Darwin, Northern Territory. NT DPIF Technote No. 92.

Childs F.D. and Jencks E.M. (1967). Effect of time and depth of sampling upon soil test results. Agron. J. **59**: 537-40

Choudbury F.A. (1986). Effect of Waterlogging on isotopically exchangeable phosphate and iron in some soils. Thai J. Agric. Sci. **19**: 221-25

Friesen D.K., Blair G J and Duncan M (1985). Temporal fluctuations in soil test values under permanent pasture in New England, NSW. Aust. J. Soil Res. **23**: 181-93

Jessop R.S., Balmer B, McClelland V.F. and Jardine R. (1977). Within-season variability of bicarbonate extractable phosphorus in wheat soils. Aust. J. Soil Res. **15**: 167-70

Kemp D.R., McDonald W.J. and Murison R.D. (1985). Temporal variation in the results of soil phosphate analyses. Aust. J. Exp. Agric. **25**: 881-5

Sorn-Srivichai P., Syers J.K., Tilman R.W. and Cornforth I.S. (1988). An evaluation of water extraction as a soil testing procedure for phosphorus II. Factors affecting the amounts of water - extractable phosphorus in field soils. Fert. Res. **15**: 225-36.

Figure 1 Rainfall and Soil Available P 1986-87