Seasonal Changes in the Ratio of Microbial Biomass P to Total P in Soils of Grazed Pastures

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Introduction Phosphorus (P) utilisation efficiency in pasture soils is higher than in arable soils. Because there is a considerable amount of microbial biomass in the root mat layer, which is peculiar to permanent pasture, the microbial biomass P (MBP) contribution may be important in supplying soil P to pasture plants (Chen *et al*., 2000; He *at al*., 1997). In the present study, we investigated seasonal changes in MBP and other forms of P relative to total soil P in two pastures in which P uptake was estimated to be different.

Materials and methods This experiment was conducted at two pastures on Silic Andosols in Field Museum Tsukui (Kanagawa prefecture) of Tokyo University of Agriculture & Technology. A pasture which had been reseeded with tall fescue (TF, *Festuca arundinacea* Schreb.) two years prior to our study and a pasture of Japanese lawn grass (JL, *Zoysia japonica* Stend.) semi-natural pasture were used. N fertiliser was applied to the TF pasture on May 22. Six core soil samples (50 cc and 0-2.5cm in depth) were taken at each of three points in each pasture on April 16 (spring), July 17 (summer) and October 16 (autumn) in 2003. Fresh samples were sieved through a 2 mm screen and used to determine MBP and Olsen P (OP). MPB was determined with a $CHCl_3$ fumigation-0.5M $NaHCO_3$ extract method with pre-incubation. A portion of the sieved soil was air-dried and used to determine total P (TP, HNO_3-$HClO_4$ digestion method) and a modified Bray No. 2 method P (BRP). All P was determined colorimetrically by the ammonium molybdate method. MBP was calculated by $K_p = 0.4$.

Results and discussion Table 1 illustrates the seasonal changes in grazed pasture soil P content. The contents of TP ranged from 2.36 to 3.77 mgP/g dry soil. Differences in TP among seasons were not significant. Throughout the season, TP in the JL pasture was higher than that in the TF pasture ($p<0.01$). The proportions of MBP and BRP to TP in the JL pasture were also higher than those in the TF pasture ($p<0.01$), even though no fertiliser had been applied to the JL pasture for 10 years. The values of MPB percentage were similar to those presented by Chen *et al.*, (2000). BRP and OP contents were similar to those for other soils (Srivastava, 1992).

Conclusions It is possible that higher MPB in the JL pasture was caused by root mat development. MBP in the JL pasture reached a minimum in spring and maximum in autumn, while in the TF pasture, maximum MPB was observed in spring and minimum in summer. He *et al.* (1997) reported that MBP reached a minimum in summer: this is consistent with the TF pasture, and inconsistent with the JL pasture, although seasonal change in MPB was not significant. Srivastava (1992) suggested that water content is the most important factor in MBP change. In our study the relationship between MBP and soil water content was not clear. Significant seasonal change was found only in BRP of TF ($p<0.01$). Examination of changes in OP and BRP and the balance between MBP dynamics and P absorption by plants would enable us to utilise pasture soil P more efficiently.

Table 1 Seasonal change in pasture soil phosphorus

		Total P (mg P/g DS)	MBP (% TP)	OP (% TP)	BRP (% TP)	BRP-OP (% TP)	Soil water content g/g dry soil
Japanese lawngrass	Spring	3.31	2.2	2.9	4.9	2.0	0.57
	Summer	3.77	2.9	1.7	6.8	5.1	0.67
	Autumn	3.68	3.3	2.5	5.2	2.7	0.63
Tall fescue	Spring	2.36	1.8	1.5	1.6	0.1	0.60
	Summer	2.92	1.0	1.8	2.2	0.4	0.67
	Autumn	2.72	1.2	2.5	4.7	2.2	0.47

MBP: Soil Microbial biomass P, OP: Olsen P, BRP: Modified Bray No. 2 P

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