

Phosphorus Dynamics in Semi-natural Grasslands

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Abstract

In general, natural grassland develops even under very low-phosphorus fertility conditions and maintains high dry-matter production. This suggests that natural grassland may have a particular system to utilize phosphorus nutrient effectively. To clarify why such natural grasslands develop under such low phosphorus fertility, we analyzed the characteristics of the phosphorus dynamics in the semi-natural grasslands receiving no fertilizer in comparison with sown grasslands.

1. In two sown grasslands, a perennial ryegrass/white clover-mixed grassland and a Kentucky bluegrass grassland, and three semi-natural grasslands, a azumanezasa-dominant, a Japanese lawngrass-dominant and a silvergrass dominant-grassland, seasonal changes in plant phosphorus concentration in 49 plant species of the grasses including pasture grasses were examined.
2. The amount of phosphorus accumulation in the aboveground shoots in the azumanezasa (*Pleioblastus chino Makino*)-dominant grassland was almost the same as that in the fertilized perennial ryegrass (*Lolium perenne*L.)/white clover (*Trifolium repens*L.)-mixed grassland. The phosphorus accumulation in the silvergrass (*Miscanthus sinesis*Andress.)-dominant grassland was half of that in the perennial ryegrass/white clover grassland, and that in the Japanese lawngrass (*Zoysia japonica Steud.*)-dominant grassland was one-seventh.
3. Semi-natural grasses maintained a considerable amount of dry-matter production even under very low phosphorus fertility conditions. In particular, azumanezasa- and silvergrass-dominant grassland maintained a high shoot biomass equal to or greater than that of the fertilized sown grassland. This fact suggests that the high efficiency of phosphorus utilization in the dry-matter production might be a primary factor in the

adaptation of natural grasses to low-phosphorus fertility.

4. Based on model analysis of the phosphorus dynamics in the Japanese lawngrass-dominant grassland without grazing and the silvergrass-dominant grassland, the following characteristics were found; In the Japanese lawngrass-dominant grassland, since the phosphorus translocation from the soil to the root was found, soil phosphorus significantly contributes to the phosphorus dynamics of this grassland, while in the silvergrass-dominant grassland, phosphorus accumulation during the growing season was found not only in the aboveground shoots but also underground. However, soil phosphorus may not be important in the phosphorus dynamics of Japanese lawngrass. Thus, the phosphorus cycle of the grassland significantly depends on the phosphorus translocation between the aboveground parts (shoots, dead shoots and litter) and underground parts (roots) in the silvergrass-dominant grassland.
5. Two general types of phosphorus dynamics in semi-natural grasslands were recognized;
 - 1) Japanese lawngrass-type grassland, which is significantly assisted by available phosphorus in the surface soil layer and phosphorus accumulated in living shoots, dead shoots, litter and roots, and
 - 2) silvergrass-type grassland, which is significantly dependant on the phosphorus translocation between the aboveground and underground parts of the plants except soil parts.

Key words: Semi-natural grassland. Phosphorus dynamics, Japanese lawngrass, Silvergrass, Olsen-P