Effect of slope aspect on arbuscular mycorrhizal colonization of centipedegrass in a hill pasture

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Introduction

Arbuscular mycorrhizal fungi (AMF) form a symbiotic association with more than 80% of terrestrial plants and benefit their hosts principally by increasing uptake of nutrients. This is particularly important for phosphorus uptakes as fungal extraradical mycelium can access relatively immobile phosphate ions through an ability to grow beyond the phosphate depletion zone that rapidly develops around the root (Gosling *et al*. 2006). This symbiotic association is known to promote growth and improve drought and disease resistance of the host plants (Gosling *et al*. 2006). Centipedegrass (*Eremochloa ophiuroides* (Munro) Hack.) is a warm-season perennial that is native to central and southern China and is widely distributed in south-east Asia, southern USA, South America, West Indies, and parts of Africa and tropical north and east Australia (Islam and Hirata 2005). Centipedgegrass (CG) has been considered to be of potential value for use in low-input grassland systems in central to southern parts of Japan. An experiment conducted in a hill pasture in the mid-altitude region of Kyushu has shown that CG is well adapted to all slope aspects (north, east, south and west) despite the aspect differences in environmental conditions (Hirata *et al*. 2007). In this study, we monitored AM colonization of CG growing on the 4 slopes of the pasture to examine aspect differences in the grass–AMF association.

Methods

The study was conducted between 2007 and 2009 on the 4 slopes (north, east, south, and west; about 25° gradient) in the hill paddock (2.4 ha, 31°49′N, 131°24′E, 540 m elevation) at the Kagamiyama Livestock Farm in Nobeoka City, Miyazaki Prefecture, southwestern Japan (Hirata *et al*. 2007). In 2000, 3 replicated plots each 2 m (down the slope) × 4 m (across the slope) were established on each of the 4 aspects and sown to CG (cv. Common). In subsequent years, the paddock was stocked by beef cows from spring (late April–early May) to autumn (October–early November), and fertilized with compound fertilizer once (spring) or twice (spring and autumn) a year at average annual rates of 70 kg N/ha and 70 kg K/ha. Sod samples (vegetation and soil) were collected to a depth of 10 cm by using an iron tube (7.5 cm diameter) in June and October 2007; May, July, August, and November 2008; and June, July, August, October, and November 2009. Plant roots were washed with tap water, and then cleaned and stained to estimate AM colonization (internal hyphae, vesicles, and arbuscules) following the Giovannetti and Mosse (1980) method. Soil samples were collected in October 2007, May and November 2008 and November 2009, and analyzed for moisture, total N, total C, available P, pH (H_2O) and electric conductivity (EC).

Results and Discussion

Slope aspect has a considerable influence on edaphic and biotic characteristics of a hilly pasture, mainly through variation in soil temperature caused by differences in solar radiation received (Lambert and Roberts 1978). In fact, soil properties almost always varied (P<0.05) between the slope aspects (Fig. 1). Soil total N, total C, EC, and moisture tended to be highest on the northern aspect, whereas soil available P and pH tended to be highest on the western and southern aspects, respectively. The highest soil moisture on the northern aspect is attributed to the lowest incident solar radiation on this shady aspect in the Northern

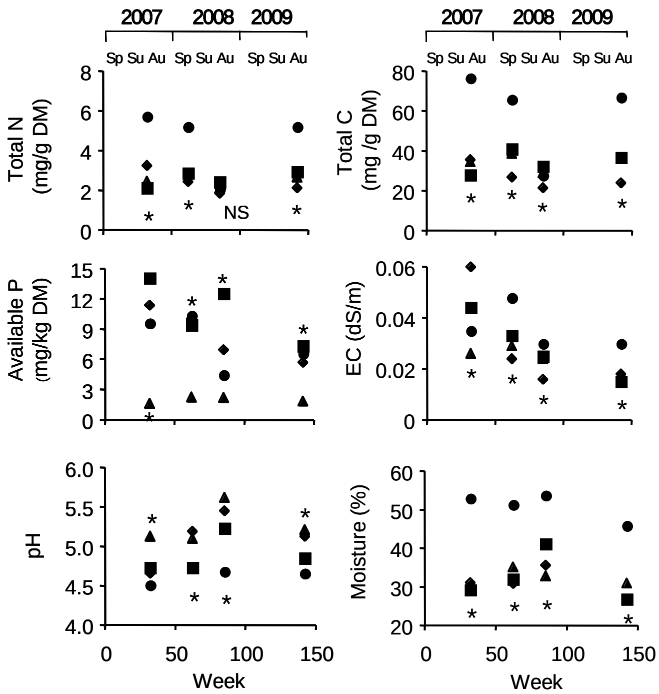

Figure 1. Soil properties in centipedegrass swards on 4 slope aspects [north (●), east (◆), south (▲), and west (■)]. Week 1 corresponds to the first week of April 2007. Asterisks indicate significant variation (P < 0.05) between the aspects.

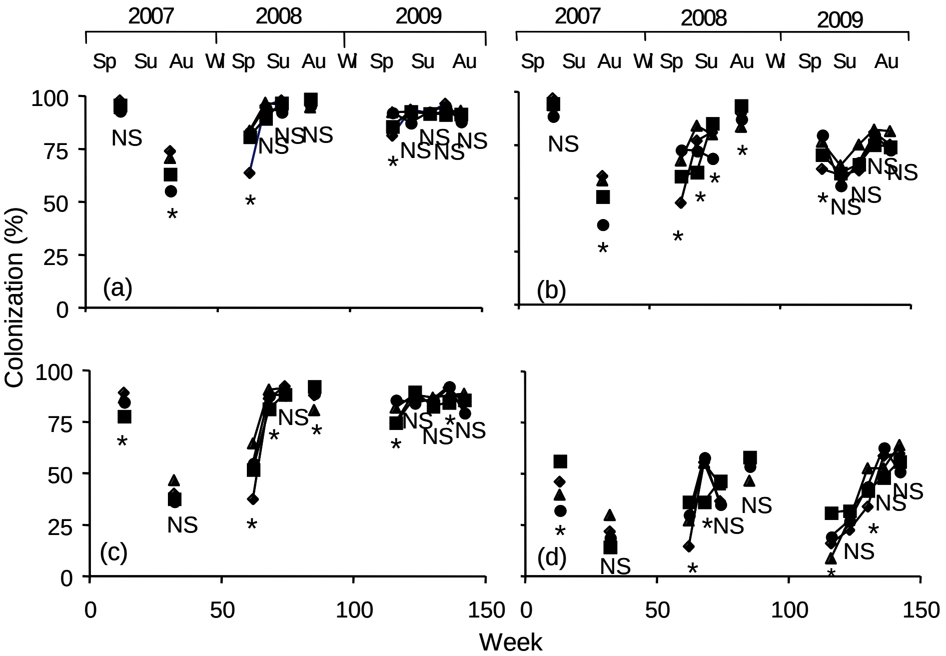

Figure 2. **Arbuscular mycorrhizal colonization (a, total mycorrhiza; b, internal hyphae; c, arbuscules; d, vesicles) of centipedegrass on 4 slope aspects (north (●), east (◆), south (▲), and west (■). Week 1 corresponds to the first week of April 2007. Asterisks indicate significant variation (*P* < 0.05) between the aspects.**

Hemisphere. The highest soil total N and total C on the northern aspect is also attributed to the lowest incident soil temperature, and soil organic matter decomposition of soil microorganism.

Despite the aspect differences in the microclimate and soil properties, CG grew well on all aspects, showing similar coverage values (>50%) for the 4 aspects (data not shown). Furthermore, AM colonization of CG, in any characteristic structures (internal hyphae, vesicles, and arbuscules), was not significantly different (P>0.05) between the slope aspects on most measurement occasions, although the colonization usually varied with seasons and years (Fig. 2). The insusceptibility of AM colonization to the slope aspects is thus interpreted as a result of vigorous growth of CG on all aspects. At the same time, in a reverse way, the good growth of CG on all aspects may be attributed to the AM colonization insusceptible to the slope aspects, as well as the ability of this grass to tolerate and grow well under both high and low temperatures (Hirata *et al*. 2007).

Conclusion

AM colonization in CG growing in a hill pasture did not differ between the slope aspects, despite the aspect differences in microclimate and soil properties. This may be a factor contributing to the high adaptability of the grass to all slope aspects.

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