Differential Responses of Antioxidant Metabpolism to Heat Stress for Warm-Season and Cool-Season Turfgrass Species

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Differential responses of antioxidant metabpolism to heat stress for warm-season and cool-season turfgrass species

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Key words : high temperature , turfgrass , oxidative stress

Introduction High temperature is a primary stress limiting growth of cool-season grass species , but less detrimental to warm-season species . Heat stress causes various physiological changes , including antioxidant metabolism . Whether interspecific variation in turfgrass tolerance to heat stress is related to differential responses of antioxidant enzyme activities is not well documented . The objective of this study was to investigate whether superior heat tolerance of warm-season zoysiagrass (*Zoygia matrella*) and was related to active antioxidant defense systems in comparison to cool-season tall fescue (*Festuca arundinacea*) .

Materials and methods Manila zoysiagrass and Barlexnus tall fescue were planted in plastic pots filled with soil . Zoyziagrass plants were exposed to the optimal temperature of 34°C or heat stress at 44°C . Tall fescue plants were exposed to the optimal temperature of 24°C or heat stress at 34°C . The experiment was conducted in a randomized block design with each temperature treatment replicated in three growth chambers . At the beginning of heat stress (0 d) and following 6 , 12 , and 18 d of heat stress , turf quality was rated based on the scale of 0 to 9 with 9 being the best (green , dense canopy) and 0 being the worst (dead turf) , and leaf tissues were sampled for the analysis of antioxidant enzyme activity . Superoxide dismutase (SOD) and ascorbic peroxidase (POD) activity were measured according to the procedures described in Jiang and Huang (2001) with modifications .

Results Elevated temperature by 10°C from the optimal level caused decline in turfgrass growth (Fig . 1) and reduction in POD activity (Fig . 2) and SOD activity (Fig . 3) and for both turfgrass species , and the decline in all three parameters was less pronounced in zoysiagrass than tall fescue . In addition , zoysiagrass plants maintained significantly higher turf quality and antioxidant enzyme activities than tall fescue following prolonged period of heat stress (after 12 d) .

Figure 1

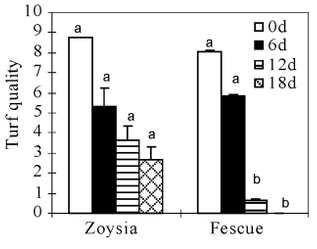


Figure 2

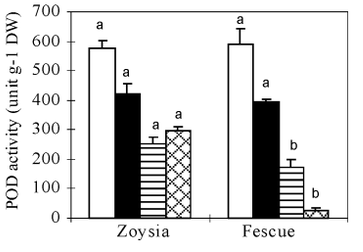
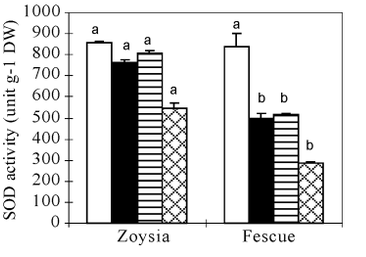


Figure3



Figures 1-3 *Changes in turf quality (Figure 1) , POD activity (Figure 2) , and SOD activity (Figure 3) during 18 d of heat stress for zoysiagrass and tall fescue . Vertical bars are standard errors at each stress duration for each species . Columns marked with lowercase letter are for comparison between zoysiagrass and tall fescue at a give day of treatment . Different letters indicate significant difference between the two species .*

Conclusions Heat stress induced oxidative damages in both warm-season and cool-season turfgrass species . Warm-season zoysiagrass was able to maintain more active antioxidant enzymes during heat stress , which could contribute at least partially to its superior turf performance under heat stress , in comparison to cool-season tall fescue .

References

Jiang , Y . and Huang , B . (2001) Effects of calcium on antioxidant activities and water relations associated with heat tolerance in two cool-season grasses . *Journal of Experimental Botany* 52 , 341-349 .