Low-Temperature Kill

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A major cause of winter injury of both cool- and warm-season turfgrasses is low-temperature kill. **It is caused by ice crystal formation and resultant stress at temperatures below 32°F (0°C).** This stress may be either an intracellular or extracellular occurrence, in which the brittle protoplasmic organization is fatally damaged via mechanical destruction. **Typically, the higher the hydration level or water content in the cells of sensitive tissues such as the meristems, the greater the likelihood of low-temperature kill. Note that low-temperature kill is distinctly different from chilling stress injury.**

A question frequently asked is—"at what temperature will a particular turfgrass species or cultivar be killed?" A knowledgeable individual will not attempt to answer this question, as it varies greatly depending on the environmental conditions during freezing and the degree of plant low-temperature hardiness as influenced by environmental and cultural factors. In terms of freezing conditions, **the absolute temperature at which a particular turfgrass is killed may vary depending on the (a) freezing rate, (b) thawing rate, (c) number of times frozen, (d) length of time frozen, and/or (e) post-thawing culture.**

Low-Temperature Kill Hardiness. The hardiness of turfgrasses to low-temperature kill involves the ability of a plant to survive potentially lethal low-temperature stress at temperatures below 32°F (0°C). It is achieved primarily by the redistribution of water, including lowering the hydration level of the critical meristematic tissues, and usually an increase in carbohydrate storage. For most turfgrass species, **temperatures between 34 and 40°F (1–4°C) are optimum for the low-temperature hardening process to occur.** The relative low-temperature kill hardiness of 31 autumn-hardened turfgrasses is shown in the accompanying table.

Influential environmental factors that contribute to low-temperature hardiness typically affect the plant tissue hydration level. They include **poorly drained soils**, with fine, clayey soil textures or compacted soil conditions, increasing the likelihood of surface water accumulations that result in increased tissue hydration. Depressional areas where water stands following intense rainfall and/or mid-winter thawing of snow also accentuate tissue hydration. **High sunlight or irradiance** enhances physiological hardening via an increased carbohydrate accumulation.

Accelerated shoot growth usually adversely increases the tissue hydration level. Influential cultural factors that may contribute to enhanced low-temperature hardiness, especially during the hardening period, include:

- high tissue potassium levels.
- moderate to low tissue nitrogen levels.
- higher mowing heights that increase carbohydrate storage.
- avoidance of excessive irrigation.
- ensuring proper surface and subsurface water drainage.
- control of excessive thatch, which elevates the nodes on lateral stems.
- selection of low-temperature hardy turfgrass species and cultivars.

Relative Low-Temperature Kill Hardiness	Turfgrass	Scientific Name
excellent	rough bluegrass	*Poa trivialis*
	creeping bentgrass	*Agrostis stolonifera*
	turf timothy	*Phleum bertolonii*
good	Kentucky bluegrass	*Poa pratensis*
	Canada bluegrass	*Poa compressa*
	velvet bentgrass	*Agrostis canina*
	crested wheatgrass	*Agropyron cristatum*
	colonial bentgrass	*Agrostis capillaris*
	redtop	*Agrostis gigantea*
moderate	creeping bluegrass	*Poa annua* var. *reptans*
	fine-leaf fescues	*Festuca* spp.
	American buffalograss	*Buchloe dactyloides*
	blue grama	*Bouteloua gracilis*
	annual bluegrass	*Poa annua* var. *annua*
	perennial ryegrass	*Lolium perenne*
	tall fescue	*Festuca arundinacea*
	meadow fescue	*Festuca pratense*
	Japanese zoysiagrass	*Zoysia japonica*
poor	dactylon bermudagrass	*Cynodon dactylon*
	manila zoysiagrass	*Zoysia matrella*
	seashore paspalum	*Paspalum vaginatum*
	hybrid bermudagrass	*Cynodon* hybrid
very poor	centipedegrass	*Eremochloa ophiuroides*
	mascarene zoysiagrass	*Zoysia tenuifolia*
	common carpetgrass	*Axonopus fissifolius*
	annual ryegrass	*Lolium multiflorum*
	bahiagrass	*Paspalum notatum*
	St. Augustinegrass	*Stenotaphrum secundatum*
	kikuyugrass	*Pennisetum clandestinum*
	tropical carpetgrass	*Axonopus compressus*
	serangoongrass	*Digitaria didactyla*