



## How tolerant are different turfgrass species and varieties to ice encasement?

*By Karin Juul Hesselsoe, Anne F. Borchert, Trond Pettersen, and Trygve S. Aamlid, NIBIO Turfgrass Research Group, NIBIO Landvik.*



# How tolerant are different turfgrass species and varieties to ice encasement?



**Photo 1-3.** Collection of samples of different varieties of bentgrass and fescue at Scangreen (NIBIO-Landvik). 2: Vacuum sealing before incubation in darkness at 0.5 °C for up to 11 weeks. 3: Opening of bag after incubation. Photos: Karin J. Hesselsøe, Anne F. Borchert and Ove Hetland.

**One of the outcomes of the ICE-BREAKER-project (2020-2024) was a screening of tolerance to ice encasement which included turfgrass species and varieties from the SCANGREEN-project 2019-2022.**

Ice encasement of turfgrass is a complex winter stress including low temperatures, complete lack of oxygen (anoxia) and the accumulation of toxic by-products of anaerobic respiration such as acetic or butyric acid. It is hard to tell which of these stresses are the most severe, but almost every year, prolonged ice encasement causes damages and costly efforts to repair greens on golf courses in Northern Scandinavia. Breeding species and varieties that are tolerant to ice encase-

ment is the best defense against such environmental stresses, and here we have the SCANGREEN-program that for more than 20 years has identified winter-hardy species and varieties for putting greens in the Nordic countries.

While tolerance to ice encasement is such an important component of winter survival, it can be very difficult to test. Field tests are often unreliable with high variability in survival because of changing winter conditions with variations in ice thickness, density and durations of the ice covers which will often preclude a fair ranking, so development of reliable laboratory tests that allow comparison of large plant materials are therefore much faster and cheaper than the field tests. But

results from such laboratory tests need to be representative to results under field conditions.

## **Simulated ice encasement in the lab**

We tested different varieties of bentgrass and fescue taken from the Scangreen trial 2019-2022 at NIBIO Landvik (Photo 1) and transferred them to the laboratory to be screened for tolerance to ice encasement. We simulated ice encasement by vacuum-sealing grass samples in plastic (Photo 2) and stored them in darkness at 0.5 °C. Samples were taken out after 5, 6, 7, 8, 9, 10 and 11 weeks in the plastic bags (Photo 3). At each outlet tiller groups were separated (Photo 4) and potted



**Photo 4-6:** 4: Tiller separation. 5: Potting tillers in trays to be 6: Transferred to growth chamber for recovery. Photos: Trygve S. Aamlid and Karin J. Hesselsøe.

(Photo 5) in trays. Trays were placed in a growth chamber at 15°C and tiller survival was determined after 28 days of recovery (Photo 6).

## Literature and field experiments

From the literature we know that the grass species can be divided into three classes according to their tolerance to ice encasement which is (more or less) similar to their ranking for freezing tolerance. Among species used on golf courses they are ranked as follows:

1. Kentucky bluegrass and creeping bentgrass,
2. Red fescue and
3. Perennial ryegrass and annual bluegrass.

Field experiments at NIBIO Apelsvoll in 2017 ranked the species/subspecies for putting greens as follows: Velvet

bentgrass > creeping bentgrass > Chewings fescue = slender creeping red fescue ≥ colonial bentgrass > annual bluegrass (Waalén et al. 2017). However, only one variety pr. species was used in this trial, and significant variation in tolerance to ice encasement among varieties of each species is likely to be the case.

## Results of the lab experiments

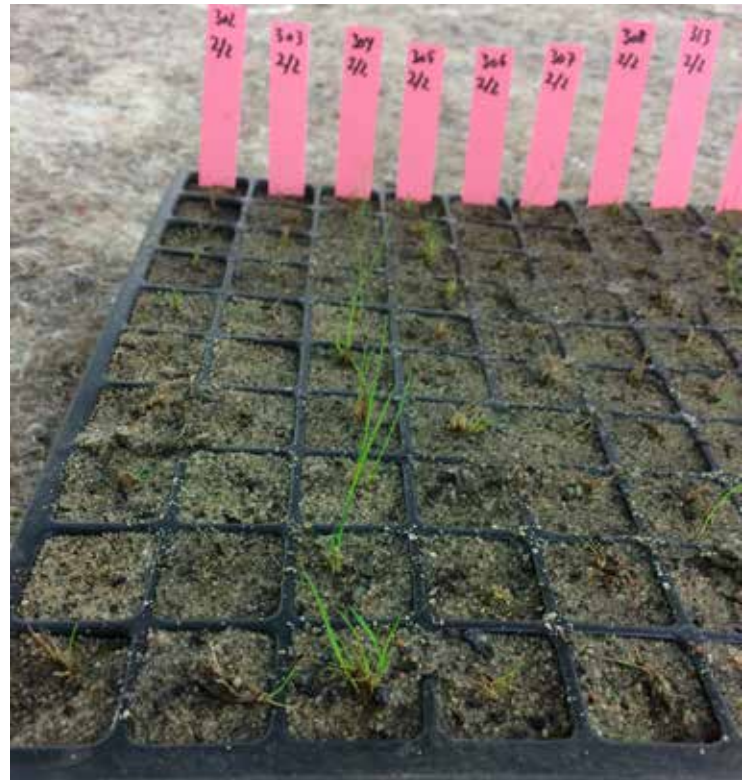
In the laboratory experiments at NIBIO-Landvik several varieties of bentgrass and fescue were tested for their tolerance to simulated ice encasement, and after 3 years of replicated lab experiments the results showed significant differences between both species and varieties (Photo 7-8).

The ranking of species showed (in agreement with the field trials) that

velvet bentgrass was superior with the variety 'Nordlys' in a class of its own with a LD50 of 9 weeks. LD50 means 'lethal duration of 50% of the plants' which means that after 9 weeks of ice encasement 50% of the plants of velvet bentgrass 'Nordlys' were alive. In comparison the second-best species was Chewings fescue with a LD50 of 7 weeks, and slender creeping red fescue and colonial bentgrass with a LD50 of 6 weeks. The species with the lowest tolerance to simulated ice encasement was creeping bentgrass, with a LD50 of only 5 weeks though one of the varieties 'Penncross' had a LD50 of 6 weeks.

The ranking of velvet bentgrass as superior to all others and of Chewings fescue as superior to slender creeping red fescue and colonial bentgrass is in agreement with the field test at Apelsvoll, but not the ranking of creeping





**Photo 7-8:** 7: Significant differences between species of bentgrass and fescue after 5 weeks of simulated ice encasement. 8: Velvet bentgrass variety 'Nordlys' was superior to all other species and varieties. Photos: Karin J. Hesselsøe and Trygve S. Aamlid.

bentgrass as having lower tolerance than any other species. In the field experiments at Apelsvoll creeping bentgrass had LD50 of at least 14 weeks, and we do not know exactly why this species performed so differently when simulating ice encasement in the lab. Compared to ice encasement in the field where there may be some oxygen left for up to 20 weeks, the vacuum-sealed plastic bags were completely anoxic (lack of oxygen),

and maybe creeping bentgrass does not tolerate this as much as the other species tested.

We need to adapt the laboratory method for simulated ice encasement so it fits better for all species including creeping bentgrass. One adjustment may be to lower the temperature during incubation from 0,5 til -0,5 °C, which may be more similar to the temperature under ice covers in the field.

Within species, the most tolerant varieties were velvet bentgrass 'Nordlys', creeping bentgrass 'Penncross', Chewings fescue 'Lykke' and slender creeping red fescue 'Finesto' and 'Cezanne'. No differences were found between the colonial bentgrass varieties 'Heritage' and 'Jorvik'.

## References

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