

In the Northern USA and Canada, the cooler temperatures of fall result in perennial grasses hardening, allowing them to survive the freezing temperature of winter. Unfortunately, climate changes are also associated with wider fluctuations in temperatures during the winter-spring interseason. Data from the past 15 years shows that air temperatures increase, and fluctuate, enough in the spring to influence grass growth. These fluctuations will result in dehardening of grasses (increased temperatures leading to crown hydration) followed by winterkill when the temperatures drop below freezing again. Therefore, our research project is to characterize the freezing tolerance of newly developed tall fescue cultivars after potential events of dehardening.

We have requested seeds of newly developed tall fescue cultivars used in the most recent National Turfgrass Evaluation Program (NTEP). For our growth chamber experiment, we were able to secure 79 tall fescue cultivars. Our first experiment was to evaluate the freezing tolerance (lethal temperature that kills 50% of the population; LT<sub>50</sub>) for all these cultivars after a period of cold hardening. We observed that -12 °C would be an appropriate temperature for freeze stress after dehardening events based on these initial freezing tolerance experiments. Our results also indicated a large variation of freezing tolerance for the tall fescue cultivars; this variation was also present within seed companies (Table 1).

**Table 1:** Average freezing tolerance (LT<sub>50</sub>) for all tested cultivars. Each seed company is color-coded.

| Cultivar       | Sponsor                           | LT <sub>50</sub> (°C) |
|----------------|-----------------------------------|-----------------------|
| Exp 8PC        | Barenbrug                         | -9.9 A                |
| TD2            | Pennington                        | -9.9 A                |
| PPG-TF 267     | Peak Plant Genetics LLC           | -10 AB                |
| TMT1           | DLF Pickseed USA                  | -10 A-C               |
| Barnoble       | Barenbrug Research                | -10.2 A-D             |
| RS1            | DLF Pickseed USA                  | -10.2 A-D             |
| Bonfire        | Jacklin Seed by Simplot/Barenbrug | -10.2 A-D             |
| PPG-TF 249     | Peak Plant Genetic                | -10.2 A-D             |
| PPG-TF 257     | Peak Plant Genetics LLC           | -10.2 A-D             |
| PST-5MINK      | Pure Seed Testing                 | -10.2 A-D             |
| SETF445        | Smith Seed Services               | -10.2 A-D             |
| SE53D2         | Smith Seed Services, LLC          | -10.2 A-D             |
| PPG-TF 313     | Columbia Seeds/The Scotts Company | -10.3 A-D             |
| 5LSS           | Pure Seed Testing                 | -10.3 A-D             |
| PST-5DZM       | Pure Seed Testing                 | -10.3 A-D             |
| PPG-TF 318     | Peak Plant Genetics LLC           | -10.3 A-E             |
| DLFPS-321/3695 | DLF Pickseed USA                  | -10.4 A-F             |
| zion           | Barenbrug USA                     | -10.6 A-G             |
| GRANDE 3       | DLF Pickseed USA                  | -10.6 A-G             |
| DLFPS-321/3696 | DLF Pickseed USA                  | -10.6 A-G             |
| Birmingham     | Grassland Oregon Seed             | -10.6 A-G             |

|                      |                                   |           |
|----------------------|-----------------------------------|-----------|
| Avenger III          | Mountain View Seeds               | -10.6 A-G |
| Tough                | Barenbrug                         | -10.7 A-G |
| Xanadu               | Barenbrug Research                | -10.7 A-G |
| DLFPS-321/3679       | DLF Pickseed USA                  | -10.7 A-G |
| PST-5TRN             | Pure Seed Testing                 | -10.7 A-G |
| BAR-FA-8230          | Barenbrug Research                | -10.8 A-H |
| PPG-TF 338           | Columbia Seeds/The Scotts Company | -10.9 A-I |
| DLFPS-321/3699       | DLF Pickseed USA                  | -10.9 A-I |
| PST-5GLBS            | Pure Seed Testing                 | -10.9 A-I |
| SETF456              | Smith Seed Services               | -10.9 A-I |
| BAR-EA-8228          | Barenbrug Research                | -11 A-I   |
| PPG-TF 323           | Columbia Seeds/The Scotts Company | -11 A-I   |
| DLFPS-321/3708       | DLF Pickseed USA                  | -11 A-I   |
| DLFPS-321/3706       | DLF Pickseed USA                  | -11 A-I   |
| DLFPS-321/3707       | DLF Pickseed USA                  | -11 A-I   |
| Dynamite G-LS        | Mountain View Seeds               | -11 A-I   |
| Titanium G-LS        | Mountain View Seeds               | -11 A-I   |
| PPG-TF 306           | Peak Plant Genetics LLC           | -11 A-I   |
| PPG-TF 316           | Peak Plant Genetics LLC           | -11 A-I   |
| RH3                  | ProSeeds Marketing Inc.           | -11 A-I   |
| PST-5DC24            | Pure Seed (Rose Agri)             | -11 A-I   |
| Monument (PST-5SQB)  | Pure Seed Testing                 | -11 A-I   |
| ZRC1                 | Z Seeds                           | -11 A-I   |
| AST8218LM            | Allied Seed LLC                   | -11.1 A-I |
| DLFPS-TF/3553        | DLF Pickseed USA                  | -11.1 A-J |
| AST5120/A-TF31       | Allied Seed LLC                   | -11.3 B-J |
| GO-RH20              | Grassland Oregon Seed             | -11.3 B-J |
| DLFPS-321/3693       | DLF Pickseed USA                  | -11.3 C-J |
| PPG-TF 305           | Peak Plant Genetics LLC           | -11.3 C-J |
| Lifeguard (PST-5NOR) | Pure Seed (Rose Agri)             | -11.3 C-J |
| PST-5E6              | Pure Seed Testing                 | -11.3 C-J |
| PST-5GQ              | Pure Seed Testing                 | -11.3 C-J |
| PST-5MCMO            | Pure Seed Testing                 | -11.3 C-J |
| KY-31                | Standard                          | -11.3 C-J |
| Kizzle K18-ROE       | The Scotts Company                | -11.3 C-J |
| DLFPS-321/3705       | DLF Pickseed USA                  | -11.4 D-J |
| DLFPS-TF/3552        | DLF Pickseed USA                  | -11.4 D-J |
| DLFPS-321/3702       | DLF Pickseed USA                  | -11.4 D-J |
| DLFPS-321/3703       | DLF Pickseed USA                  | -11.4 D-J |
| DLFPS-TF/3550        | DLF Pickseed USA                  | -11.4 D-J |
| Firecracker G-LS     | Mountain View Seeds               | -11.4 D-J |
| PPG-TF 231           | Peak Plant Genetics LLC           | -11.4 D-J |
| PPG-TF 320           | Peak Plant Genetics LLC           | -11.4 D-J |
| PPG-TF 244           | Peak Plant Genetics LLC           | -11.4 D-J |
| GLX ACED (PST-5DART) | Pure Seed (Rose Agri)             | -11.4 D-J |

|                |                          |           |
|----------------|--------------------------|-----------|
| SESCRI         | Smith Seed Services, LLC | -11.4 D-J |
| SETF104        | Smith Seed Services, LLC | -11.4 D-J |
| NP3            | Pennington               | -11.6 E-J |
| RH1            | ProSeeds Marketing Inc.  | -11.6 E-J |
| AST8118LM      | Allied Seed LLC          | -11.6 F-J |
| Stealth        | Mountain View Seeds      | -11.6 F-J |
| PPG-TF 262     | Peak Plant Genetics LLC  | -11.6 F-J |
| K18-RS6        | The Scotts Company       | -11.6 F-J |
| DLFPS-321/3694 | DLF Pickseed USA         | -11.7 G-J |
| GO-AOMK        | Grassland Oregon Seed    | -12.1 H-J |
| K18-WB1        | The Scotts Company       | -12.1 IJ  |
| Raptor LS      | Mountain View Seeds      | -12.4 J   |

We have started two runs of the dehardening experiment in controlled conditions. All tall fescue cultivars used in the initial LT<sub>50</sub> experiment will be grown and cold hardened using a simulated fall/winter environment, then plants will be exposed to dehardening conditions (12°C) for either 1 or 5 days. Following dehardening, plants will be frozen at -12°C to see if they maintained freezing tolerance through the dehardening treatment. We are planning two additional runs for statistical analysis. Data observations will consist of photochemical efficiency (Fv/Fm; a measure of plant stress), turf quality, and digital image taken after 0, 2, 4, 8, 16 and 21 days of recovery to examine winter damage.

In September 2021, we seeded our dehardening experiment in field conditions using a seeding rate of 2 PLS (pure live seeds) / cm<sup>2</sup>. Plots were irrigated as needed, fertilized with 4.9 g N / m<sup>2</sup> and mowed a three times to 8.9 cm. In Feb-March 2022, 3 replicates will be subjected to a 1 day of dehardening conditions, while another 3 will be subjected to 5 days of dehardening, and the remaining 3 replicates will not be artificially dehardened. Plots will be dehardened by covering the respective plots with polyethylene plastic sheeting, and continually blowing in hot air with several heaters. Temperature will be monitored to make sure that thawing is occurring. In addition, the snow cover and air temperature will be monitored for all plots during the whole winter and spring. Later, spring green up, Fv/Fm, TQ, and digital image will be taken on all plots.