The Effect of the Plant Growth Regulator Primo on Winter Hardiness Levels

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Summary

Considerable growth reduction in the spring under a putting green winter cover was observed at an Alberta golf course, which prompted the development of this trial. As a result, the objective was to determine the effect of the growth regulator, Primo MAXX, on fall hardening and spring dehardening of annual bluegrass (*Poa annua).*

A single application of Primo Maxx was applied at three different rates in the late fall to an annual bluegrass (Petersen's creeping bluegrass) putting green located at the Prairie Turfgrass Research Centre in Olds, Alberta. Individual treatments were then subjected to various dehardening temperatures for various periods of time. After a freeze test, plants were re-grown and their relative hardiness levels were assessed.

Unfortunately, an equipment failure created a problem with the experimental methods and caused great variation within individual samples. To ensure that this does not happen in the future, the methodology for this study will be revised. As well, an alteration to the treatment schedule will be undertaken to assess more individual applications over different time periods.

Introduction

Previous work conducted at the Prairie Turfgrass Research Centre attempted to determine the effects of temperature and crown moisture content on the hardening and dehardening of annual bluegrass putting greens throughout winter.

Results of the trial showed that plants harden in the fall in response to a decline in temperature (2). Cool temperatures begin the hardening process while a period of freezing temperatures is necessary to completely harden the turfgrasses. As plants harden their crown moisture content decreases and their ability to resist freezing temperatures increases. In this trial hardiness levels were measured and were recorded as LT_{50} values or the lethal temperature required to kill 50% of the plants.

Generally, the opposite effect occurs in the spring. As temperatures increase, plants begin to break dormancy and initiate growth. It is believed that one of the first plant responses to warmer temperatures is a re-hydrating of the plant tissues which causes an initial loss of hardiness. Further warm temperatures trigger a growth response in the plants and new growth with noticeable greening. The warmer the temperature and the greater the duration of warm temperature, the greater the loss in hardiness.

Many golf course superintendents use protective winter covers on annual bluegrass putting greens to counter the negative effects of winter. In the past, common thinking has been to warm turfgrasses in the spring so that new growth may be initiated. However, increased temperatures under covers can create problems of excessive growth and a resulting loss of hardiness.

A local superintendent attempted to reduce the effects of the warm temperatures by applying the growth regulator, Primo MAXX, prior to the installation of the winter covers in the fall. The thought was that if growth could be reduced, covers would not need to be removed for mowing and the turf would retain its hardiness.

Although this new growth regulator has not been used for this purpose, Gusta et al, (1988) reported foliar application of plant growth regulators inhibited gibberillin biosynthesis and increased the freezing tolerance and winter survival of winter cereals.

In their promotional literature Syngenta states that using Primo MAXX prior to stress periods leads to healthier plants that tolerate stresses such as drought and cold, which helps plants to recover from stress much more quickly than non-treated turf. They also mention that Primo MAXX positively affects grass grown in shady areas where abiotic and biotic stresses can be quite prevalent. Reports from superintendents also state that the use of Primo MAXX increases plant density and increases root development.

As a result of these observations, the objective of this study was to determine the effect of Primo MAXX on fall hardening and spring dehardening of annual bluegrass.

Methodology

The growth regulator, Primo MAXX, active ingredient Trinexapac-ethyl, was applied at three different rates to annual bluegrass (Petersen's creeping bluegrass) plots located at the Prairie Turfgrass Research Centre (Olds, Alberta, Canada). Three application rates, 4 ml, 8 ml and 12 ml/100m^2, were made just prior to permanent freeze-up on 28 October 03. Following application the product was left for four hours to dry on the plant surface prior to sample collection with a 2" soil sampling tube. Individual samples were placed in a growth chamber (Conviron PGW 36 Winnipeg, Manitoba) and were maintained for five days at 10^{o}C/2^{o}C day/night temperatures to ensure the complete uptake of the product. Following this the samples were place in a freezer (Revco Freezer/incubator B0D 30A) at –2^{o}C for an additional 3 weeks in order to fully harden the plant material. Following this, untreated plants were assessed for relative hardiness prior to the initiation of the dehardening treatments. As annual bluegrass normally can withstand temperatures of –20^{o}C, these baseline relative hardiness levels (LT_{50}'s) should be an indication of full hardiness of annual bluegrass plants.

Treated samples were then placed back in the growth chamber and were subjected to various temperatures for various periods of time in order to create a situation where plants would deharden. These conditions were created to simulate springtime conditions in the field. Plants were subjected to three different temperature regimes in the growth chamber: 4^{o}C/2^{o}C, 8^{o}C/2^{o}C and 12^{o}C/2^{o}C day/night temperatures, with lights on for 12 hours a day. A combination of cool white fluorescent and incandescent lighting (8:1) was used, with an irradiance of 360um and 94w/m2 as determined by a Li-Cor LI-1000 photometer. The various treatments were subjected to these temperatures for various periods of time: 24, 48, 72 and 96 hours. As dehardening is a function of time and temperature, it was expected that those plants that were in the growth chamber for the longest periods of time at the highest temperatures would lose the greatest level of hardiness. Following the time and temperature treatments, plants were subjected to a freeze test.

A low temperature programmable freezer (Forma Model 8270/759M Freezer with a Watlow 982 programmable controller) was used for the freeze test. Turf cores were divided into six individual samples and placed into colour coded cells (2.5 cm) in propagation plug trays. A piece of moist paper towel was placed in the bottom of each cell to act a nucleator for the individual samples. These samples were allowed to acclimatize in the freezer for a minimum of two hours at -2^{0}C. Following this the temperature was decreased in a step-wise fashion by 2^{0}C/hour. When the temperature was in the selected range, individual cells in the propagation trays were removed for each treatment before the temperature was further decreased by 2^{o}C. Following the freeze test, samples were thawed for 24 hours at 4^{o}C in the incubator, divided into individual plants, and transplanted into propagation trays. Plants were then transferred to the greenhouse for four weeks at 18^{o}C/10^{o}C day/night temperatures with supplemental lighting. After four weeks, plant re-growth was rated for survival in order to establish LT_{50} values. LT_{50} values are considered to be the lethal temperature that is required to kill 50% of the plants. Four successive freeze tests were used as replicates.

Results

Results of this trial were extremely variable and it is not possible to comment on the results of the various treatments.

A malfunction of the incubator where temperatures rose to 18^{o}C over a weekend period, likely caused the plants to deharden. However, this should have occurred to all plants and it is thought that drought stress may also have been a factor in the loss of hardiness. As the plant material was only intended to be in the incubator for a short period of time, this problem was not anticipated. In future, plants will be either packed in snow or sealed in containers in order to reduce the potential for dehardening. There may need to be some experimentation on the methodology in order to improve the reliability.

Discussion

This trial was intended to evaluate the effect of a late application of the Primo MAXX on the hardening and dehardening of the plants. Three rates of application were tested at that time.

This may not, however, be the most appropriate treatment schedule. Generally, the product is applied throughout the active growing period on a 2-3 week interval. It is proposed for a future trial that treatments may compare a summer application program versus a fall program that would be applied just prior to and during the hardening phase.

References

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3. Tompkins, D. K., J.B. Ross, and D.L. Moroz. 2000. Hardening of annual bluegrass and creeping bentgrass in fall and early winter. Trial in progress.

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