# JACKLIN BENTGRASS: L-93

## ‘L-93’ Creeping Bentgrass Research Update
## Plant Growth Regulators, Thatch Control, Fertility, and Wetting Agents

By Christian Baldwin, Ph.D.


## SUMMARY

Plant Growth Regulators

- **Lower rates and more frequent Primo (trinexapac-ethyl) applications are more effective at suppressing ‘L-93’ creeping bentgrass vertical leaf growth, enhancing green speeds, and providing a more consistent/uniform ball roll compared to higher rates and less frequent Primo applications.**
- **Mowing once daily along with routine application of gibberellic acid inhibiting plant growth regulators, such as Primo or Cutless (flurprimidol), produce similar ball roll distances compared to mowing twice daily.**
- **Multiple studies have shown that repeated Proxy (ethephon) use is not suitable for a monostand ‘L-93’ creeping bentgrass putting green maintained at 0.125 inch mowing height. Typically, turfgrass quality and ball roll distances are negatively impacted.**

Thatch Control

- **In a newly seeded ‘L-93’ creeping bentgrass putting green, percent organic matter can increase from 0.62% to 123% in just two years if appropriate cultivation techniques are not utilized.**
- **In a newly seeded ‘L-93’ creeping bentgrass putting green, topdressing alone, vertical mowing alone, grooming alone, core cultivation alone, or a biological product (Thatch-X) is ineffective in minimizing thatch-mat accumulation over a two-year establishment period. A combination of these cultural practices is necessary for the most effective thatch-mat control program.**

Fertility

- **An ideal nitrogen (N) rate for a successful ‘L-93’ creeping bentgrass putting green in a heat-stressed environment ranges from 4 pounds per 1000ft$^2$ to 6 pounds per 1000ft$^2$ per year.**
- **Combining 50% foliar and 50% granular N fertilizer sources result in better ‘L-93’ creeping bentgrass quality compared to only 100% foliar or 100% granular N fertilizer sources.**
- **Applying a granular source of potassium at 4lbs per 1000ft$^2$ increases ‘L-93’ creeping bentgrass putting green quality compared to a liquid potassium source in a heat stressed environment in the transition zone.**

Wetting Agents

- **Wetting agent application alleviates bentgrass summer stress symptoms; however, success appears to be dependent on soil moisture content.**
- **Aqueduct, Brilliance, Cascade Plus, Hydro-Wet, LescoFlo, Primer Select, and TriCure wetting agents are most effective in alleviating soil hydrophobicity on a ‘L-93’ creeping bentgrass putting green. Meanwhile, Nalad, Surfside 37, and Respond 2 wetting agents are least effective in alleviating soil hydrophobicity.**



JACKLIN SEED by Simplot

RESEARCH UPDATE

5300 W. Riverbend Avenue · Post Falls, ID 83854 USA
Ph: 1-800-688-SEED · www.jacklin.com

## Minimizing mowing, fertility, and herbicide inputs, while increasing green speeds, improving ball roll uniformity/playability, and enhancing turfgrass quality of 'L-93' creeping bentgrass through plant growth regulator regimes.

Plant growth regulators (PGRs) are an integral part of a turfgrass manager's maintenance program, regardless of the turfgrass cultivar/species managed. Advantages of routine PGR use include vertical growth inhibition, improved leaf color, clipping yield reductions, and minimizing seedhead production. Popular PGRs for high maintenance turfgrass sites include Primo Maxx (trinexapac-ethyl), Trimmit (paclobutrazol), Cutless (flurprimidol), and Proxy (ethephon). Recently, researchers across the country have evaluated PGRs effectiveness in reducing mowing frequency, enhancing disease resistance, decreasing weed pressure, enhancing turfgrass establishment, increasing ball roll, and mitigating environmental stresses such as drought, heat, salinity, cold, and shade.

<u>The following PGR studies were conducted at Clemson University</u>

Previous studies have noted applying Primo in combination with proxy is effective in suppressing *Poa annua* seedhead development on creeping bentgrass putting greens. However, the effect of Primo + Proxy applications on bentgrass quality and playability has not previously been reported. McCullough et al. (2006) investigated whether Proxy applications could enhance the growth regulation effects of Primo and determined the effects of applying Primo and Proxy on 'L-93' creeping bentgrass putting green quality and playability. Proxy was applied at 0, 3.8, or 7.6 kg a.i. $ha^{-1}$ along with Primo at 0 or 0.04 kg a.i. $ha^{-1}$ every 4 weeks from May to August. Regarding quality, Proxy alone resulted in unacceptable TQ due to a lighter green leaf color. On the other hand, Primo alone consistently enhanced TQ over the 12 week study. Applying Proxy alone reduced root biomass 25% for the high application rate; however, applying Primo alone also reduced bentgrass root biomass 15% compared to non PGR treated plots. Compared to non PGR treated plots, Primo alone enhanced ball-roll distances, while Proxy decreased ball roll distances. Overall, routine Proxy use did not improve ball-roll distances or enhance growth regulation effects of Primo.

In a similar study, McCullough et al. (2005a) investigated the impact of applying Proxy; in combination with other PGRs effect on 'L-93' creeping bentgrass quality and ball roll distances. Plant growth regulators selected included Cutless (0.28 kg a.i. $ha^{-1}$), Trimmit (0.28 kg a.i. $ha^{-1}$), Primo (0.05 kg a.i. $ha^{-1}$), and Proxy (3.8 kg a.i. $ha^{-1}$). All of these PGRs were applied once in mid-May. An additional Proxy (3.8 kg a.i. $ha^{-1}$) application occurred 6 days after the other initial PGR applications. Applying Cutless, Trimmit, and Primo alone, without the additional Proxy application, increased ball-roll distances 1 week following application compared to non PGR treated plots. One-week following the initial Proxy application, ball roll was reduced compared to non-Proxy treated plots. Also, applying Proxy 6 days after the initial Trimmit, Primo, and Cutless applications reduced ball roll distances and decreased TQ. When not receiving the additional Proxy application, 'L-93' creeping bentgrass treated with Primo had greater TQ, while Trimmit and Cutless had similar TQ compared to non-PGR treated bentgrass. Meanwhile, Proxy consistently resulted in unacceptable TQ ratings.

To determine how to maximize 'L-93' creeping bentgrass green speeds, McCullough et al. (2005b and c) investigated various Primo application regimes and determined the interaction between multiple PGR applications and mowing operations. In one study, Primo was applied at 0.017 kg $ha^{-1}$ every week, 0.033 kg $ha^{-1}$ every two weeks, or 0.05 kg $ha^{-1}$ every three weeks from May through August. By the end of August, all plots received a yearly Primo application rate of 0.2 kg $ha^{-1}$. Regarding the timing of Primo applications, greater ball roll distance fluctuation was noted in plots treated with Primo every two or three weeks compared to the weekly Primo regime. This suggests that lower Primo rates applied more frequently are more effective at suppressing leaf growth and enhancing ball roll speed and consistency of 'L-93' creeping bentgrass than higher Primo rates spaced further apart. In the other study, when treated with either Cutless (0.28 kg $ha^{-1}$), Trimmit (0.28 kg $ha^{-1}$) or Primo (0.05 kg $ha^{-1}$), 'L-93' creeping bentgrass that was mowed once in the morning had greater or equal ball roll distances than non PGR treated bentgrass that was mowed once in the morning plus an additional mowing later the same day. This suggests that a turfgrass manager may be able to minimize mowing inputs without a reduction in greens speed through PGR use. As with previous studies, Proxy reduced 'L-93' creeping bentgrass ball roll compared to non Proxy treated bentgrass.

**Take-home message based on these PGR studies**

Proxy has been shown to reduce *Poa annua* populations and seedhead production in other bentgrass cultivars and turfgrass species; however, Proxy results in reduced ball roll distances and lower TQ scores 24 hours following initial application. Also, Proxy applications negatively impact an 'L-93' creeping bentgrass putting green for several weeks following an initial application. Therefore, unless no other option is available for *Poa annua* control, Proxy should be avoided on an 'L-93' creeping bentgrass putting green as ball roll and quality may be compromised.

To maximize 'L-93' creeping bentgrass putting green speed without a reduction in quality, applying Primo at lower, yet frequent rates is suggested. Also, by using appropriate PGRs, (Primo, Cutless, and Trimmit) **mowing requirements can be reduced** without a reduction in greens speed.

McCullough, P.E., H. Liu, L.B. McCarty. 2006. Ethephon and trinexapac-ethyl influence on creeping bentgrass growth, quality, and putting green performance. Online. Applied Turfgrass Science doi:10.1094/ATS-2006-0324-01-RS.

McCullough, P.E., H. Liu, L.B. McCarty. 2005a. Ethephon and gibberellic acid inhibitors influence creeping bentgrass putting green quality and ball roll distances. HortScience 40(4):1902-1903.

McCullough, P.E., H. Liu, L.B. McCarty. 2005b. Trinexapac-ethyl application regimes influence creeping bentgrass putting green performance. HortScience 40(7):2167-2169.

McCullough, P.E., H. Liu, L.B. McCarty. 2005c. Mowing operations influence creeping bentgrass putting green ball roll following plant growth regulator applications. HortScience 40(2):471-474.

## Cultural, mechanical, and biological practices to minimize thatch development in a newly seeded 'L-93' creeping bentgrass putting green

Cultivation is a routine practice on putting greens because it relieves compaction, allows deeper/faster water, air, and fertilizer penetration, reduces localized dry spots, and removes and controls thatch by promoting soil microorganism activity. Thatch is a tightly intermingled layer of living and dead stems, leaves, and roots that develops between the green turfgrass vegetation and soil surface. Mat is a brown to tan colored tightly intermingled layer of thatch intermixed with the soil. Thatch is often difficult to control due to its high lignin content, which resists decomposition from microbial activity. Increased disease and insect invasion, decreased water infiltration rates, greater localized dry spot occurrence, and reduced pesticide effectiveness and tolerance to cold temperature can all be attributed to excessive thatch levels. Thatch accumulation in newly seeded bentgrass putting greens occurs rapidly. Therefore, at Clemson University, McCarty et al. (2005) investigated multiple cultural, mechanical, and biological practices to minimize thatch-mat development on a newly seeded 'L-93' creeping bentgrass putting green.

Treatments included:

Topdressing rates
- 0.6mm (0.02inches) twice a month from March to October
- 1.2mm (0.05inches) once a month from March to October

Core cultivation
- Hollow tines were used at 76.2mm (3inches) depth.
- 15.8mm (0.62inches) diameter tines in March and September
- 6.4mm (0.25inches) diameter tines in May and June

Vertical mowing (blades were spaced 25mm (0.98inches) apart)
- Depth of 6.4mm (0.25inches) in March, May, September, and October
- Depth of 19.1mm (0.75inches) in March and October

Grooming
- Performed twice a week from April to September
- Depth of 3mm (0.12inches)

Thatch –X, biological control agent
- Applied at 146.4 kg $ha^{-1}$ in May and July
- Has a fertilizer analysis of 4-2-5, $N;P_2O_5:K_2O$.
- It contains "selected microorganisms and other bioactive ingredients" which is supposed to accelerate thatch development

Core cultivation + grooming
- Four annual core cultivations and grooming every two weeks

Core cultivation + vertical mowing
- Four annual core cultivations and two annual vertical mowings

Core cultivation + grooming + vertical mowing

Four annual core cultivations, groomed twice a week, and verticut twice a year.

Untreated

No cultural, mechanical, or biological treatments

All treatments had inconsequential effects on ball-roll and all treatments resulted in acceptable TQ following all the treatment applications. However, core cultivation minimally reduced TQ scores due to mower scalping following a cultivation event, but scores remained above the acceptable threshold.

Regardless of treatments, thatch depth increased during the study for all treatments. Compared to only topdressing, core cultivation + grooming, core cultivation + verticutting, and core cultivation + grooming + verticutting reduced thatch depth 10%, 16%, and 18%, respectively. Also, combining all three mechanical methods was more effective than core cultivation + grooming; however, no difference was detected between all three mechanical practices and core cultivation + verticutting in reducing thatch depth.

Vertical mowing, topdressing, grooming, or Thatch-X applications had similar surface hardness compared to untreated plots. However, all treatments that included core cultivation treatments reduced surface hardness by an average of 19% compared to untreated plots. However, grooming + vertical mowing did not provide additional benefits in reducing surface hardness. Regarding water infiltration, treatments that included core cultivation increased infiltration rates (57% in year I, 188% in year II) compared to the untreated.

At the end of the study, core cultivation + grooming + vertical mowing had 53% organic matter, while the untreated had 123% organic matter content. Core cultivation + vertical mowing had 23% less organic matter content compared to the untreated plots, while core cultivation + grooming + vertical mowing had 31% less organic matter content than topdressing alone. Meanwhile, core cultivation + grooming + vertical mowing averaged 24% less organic matter content than vertical mowing four times annually, grooming alone, or core cultivation alone.

McCarty, L.B., M.F. Gregg, J.E. Toler, J.J. Camberato, and H. S. Hill. 2005. Minimizing thatch and mat development in a newly seeded creeping bentgrass golf green. Crop Sci. 45:1529-1535.

## Fertilization: Liquid vs. Granular, Which to choose when managing an 'L-93' creeping bentgrass putting green?

Turfgrass managers fertility programs are generally granular-based (primarily root uptake, soil nutrition) or liquid-based (primarily foliar uptake, but root uptake does occur). So, the question typically arises: should a superintendent rely exclusively on granular fertilizers or liquid fertilizers? The decision between liquid or granular fertilization often arises as superintendents consider agronomic issues, analyze current fertilizer inventory, and prepare future budgets. There are many advantages and disadvantages of solely relying on a granular or liquid-based fertility program.

Foliar advantages include:

- Water-soluble forms can quickly correct plant nutrient deficiencies,
- Provides nutrients directly to the plant leaf tissue,
- Quick color response following application,

Uniformity of application is often improved

Foliar disadvantages include:

- Frequent applications at low rates are required because turfgrass response is temporary and leaf burn may occur if applied at high rates,
- Certain nitrogen sources, such as urea, may volatilize,
- Operator must be trusted when spraying foliar fertilizers,

A large amount of nitrogen, phosphorus, or potassium can not be applied in one application due to leaf burn potential.

Granular advantages include:

- Typically, easier to calculate and operate equipment for application,
- Provides a good soil-based fertility program,
- May not get a rapid flush of growth

Granular disadvantages include:

- A significant amount of granular fertilizers may be removed from mowing,
- May have spotted or speckling effect on turfgrass,

Granular fertilizers may be held in thatch layer, thereby, reducing its effectiveness

The following fertility studies were conducted at Clemson University

To determine the most effective fertility program for an 'L-93' creeping bentgrass putting green, Totten et al. (2007 and 2008) investigated different rates and forms of N fertility. In the first study, two annual N inputs of 2.5 and 4.0 lbs N per 1000ft$^2$ (127 and 190 kg ha$^{-1}$) using 100% granular urea, 50% granular urea + 50% liquid urea, or 100% liquid urea fertilizer were implemented. All fertilizers were applied in 14-day intervals from April through November. Regardless of N source, a decrease in visual TQ was noted at the 2.5 lbs per 1000ft$^2$ rate, while no TQ decrease was noted at the 4.0 lbs per 1000ft$^2$ rate as the season progressed from spring to fall. When N was applied at 4.0 lbs per 1000ft$^2$, 100% liquid and 50% liquid + 50% granular treatments remained above the acceptable threshold, while 100% granular treatment TQ was below the acceptable threshold. Based on this study, it appears a N rate of at least 4.0 lbs per 1000ft$^2$ is required for an acceptable stand of 'L-93' creeping bentgrass.

In a separate field study, Totten et al. (2007) subjected an 'L-93' creeping bentgrass to four annual N rates at 2, 4, 6, and 8 lbs per 1000ft$^2$ as either 100% granular urea, 50% granular urea + 50% liquid urea, or 100% liquid urea. Throughout the study, applying N below 4 lbs per 1000ft$^2$ per year promoted thin turf and algae infestations in the spring, while N rates exceeding 6 lbs/1000ft$^2$ per year reduced TQ, root mass, and root carbohydrate status in the summer.

**Take-home message based on these fertility studies**

While superintendents may solely rely on one method/source of fertilization, it appears that combining both liquid and granular type fertilizers is most suitable for an 'L-93' creeping bentgrass putting green. With the addition of a foliar component to a fertility program, 'L-93' creeping bentgrass TQ was significantly greater compared to a 100% granular based N program. This is possibly due to more uniform coverage of the fertilization or less removal of granular fertilizer that remains on the surface the subsequent mowing. Regarding rates, exceeding an annual N rate of 6lbs per 1000ft$^2$ seems detrimental for long-term successful 'L-93' creeping bentgrass putting green, while N less than 4 lbs per 1000ft$^2$ also reduces quality. Therefore, an ideal N rate appears to range from 4 pounds per 1000ft$^2$ to 6 pounds per 1000ft$^2$ per year.

Totten, F.W., H. Liu, L.B. McCarty, C.M. Baldwin, D.G. Bielenberg, and J.E. Toler. 2008. Efficiency of foliar versus granular fertilization: a field study of creeping bentgrass performance. Journal of Plant Nutrition 31:972-982.

Totten, F.W., L.B. McCarty, and H. Liu. 2007. Optimal rates of nitrogen fertilization for creeping bentgrass. Golf Course Management 75:110-114.

**Wetting agents, do they work and how effective are they?**

Localized dry spots (LDS) are a major concern for golf course putting greens which contain greater than 80% sand. Typically, LDS become problematic with excessive thatch accumulation, compacted soil, poor irrigation coverage, and hydrophobic soils. Hydrophobic soils arise when sand particles are covered by an organic coating, which occurs when humic and fulvic acids are deposited by microbial activities. Wetting agents have previously been shown to be effective in preventing and alleviating LDS from occurring. By definition, wetting agents lower the surface tension of a liquid by modifying is surface characteristics. Therefore, wetting agents are capable of decreasing the time it takes for water to infiltrate the soil profile.

At Clemson University, Sarvis et al. (2008) determine the effectiveness of a wetting agent in combination with two potassium sources in alleviating 'L-93' creeping bentgrass summer stress. A wetting agent (Revolution, Aquatrols Corp.) was applied every month from May to October at 6oz per 1000ft$^2$. Potassium was applied as a liquid or granular source. Liquid potassium was applied every two weeks at 0, 2 or 4 lbs per 1000ft$^2$. Granular potassium was applied once in the spring and twice in the fall following aerification at 0, 2 or 4 lbs per 1000ft$^2$. Granular fertilizer was applied following aerification. The granules were swept into the aerification holes and then topdressed. For quality, lowest TQ was noted when applying liquid potassium (regardless of rate), due to photo-toxicity from the liquid source. The granular potassium source at 4 lbs per 1000ft$^2$ consistently showed highest TQ scores. Regarding wetting agent use, success was variable depending on year and climatic conditions. In year I, with 24 inches of rainfall during the study period, wetting agent use led to a decline in quality during the summer, while in year II, with only 10.4 inches of precipitation, use of the wetting agent significantly enhanced 'L-93' creeping bentgrass summer TQ. Therefore, it appears when soil moisture levels were adequate, the wetting agent prevented soil cooling at night, which resulted in high soil temperatures, leading to a TQ decline. When drought conditions were persistent in year II, the wetting agent was able to retain sufficient soil moisture resulting in increased TQ.

At Michigan State University, a 'L-93' creeping bentgrass putting green maintained at 0.156 inches was subjected to several different wetting agent products from June to October, 2003 and from May to October, 2004. The following wetting agent products were used: Aqueduct, Brilliance, Cascade Plus, Hydro-Wet, LescoFlo, Nalad, Primer Select, Respond 2, Surfside 37, and TriCure. All products were applied in rates ranging from 4 to 32 oz/1000ft$^2$. The water-droplet-penetration test was used to determine soil hydrophobicity. Briefly, soil plugs were taken from the green and droplets of water were applied at different depths along the soil plug. Therefore, the less time it took a drop of water to penetrate the soil plug, the more hydrophilic (hence, the more effective the product) the plug is.

TQ ratings among all the wetting agents used were similar; however, Nalad and the untreated (no wetting agent) had the lowest TQ scores compared to other wetting agent treatments. Between the two year study, Nalad, Surfside 37, Respond 2, and untreated plots had the slowest water-droplet-penetration times, while Aqueduct, Brilliance, Cascade Plus, Hydro-Wet, LescoFlo, Primer Select, and TriCure had the fastest water-droplet-penetration times.

**Practical results of the wetting agent studies:**

Wetting agents do differ in respect to time allowing water infiltration into the soil profile. Therefore, caution and research should be completed before wetting agent selection. The potential for water conservation is **real** as untreated plots water infiltration rates were consistently slower compared to most wetting agent treatments.

Sarvis, W.G., H. Liu, L.B. McCarty, and J.E. Toler. 2008. Wetting agents provide ways to manage summer stress of bentgrass in the transition zone. Turfgrass Trends 5:74-76.

Throssell, C. 2005. GCSAA-USGA wetting agent evaluation. USGA Turfgrass and Environmental Research Online. 4 (15):52-89.