NC STATE

Effect of Fraise Mowing on Soil Physical Properties

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Introduction

With sport participation continuing to rise, sports field managers must be proactive in mitigating soil compaction (Brown and McCarty 2004). Daily turfgrass traffic is restricted to the surface 7.5 cm of the soil profile (Minner and Valverde, 2005), and field managers use an array of soil cultivation methods to lower the soil compaction of their fields. However, the most aggressive cultivation methods such as hollow tine aerification have been reported to only impact 22% of the field's surface area (Atkinson 2012).

Through a series of rotating tines/teeth, fraise mowers remove and discard all plant and soil material from 0 to 5 cm (0 to 2 in) depths in a single pass. With the majority of athletic field soil compaction occurring within the upper 7.5 cm of the soil profile, fraise mowing is an attractive alternative to alleviate soil compaction.

To test the effect of fraise mowing on soil compaction, three trials were conducted during the spring and summers of 2016 and 2017 on sand-based athletic fields at UNC Chapel Hill. Plots were subjected to simulated foot traffic, followed by fraise mowing. To assess the impact of fraise mowing on soil compaction, soil physical properties were measured both before and after fraise mowing.

Objectives

To evaluate fraise mowing as a viable cultivation method to remove surface compaction.

Materials and Methods

Locations:
- UNC Kenan Memorial Stadium (Kenan)-Summer 2016
- UNC Navy Football Practice Field (Navy)- Spring 2016 & 2017

Treatments:
- Traffic was applied to previously used fields with a Baldree traffic simulator at 0, 10, 20, 30 passes (0, 20, 40, 60 football games, respectively).(Fig. 1 & 2)
- All plots were fraise mowed at 1.9 cm depth with a Blec Combinator and digging rotor (Fig. 3).

Experimental Design: RCBD with 4 blocks. Plots measured 0.7 x 1.8 m.

Data Collected: All measurements were taken pre-and post-fraise mowing.
- Saturated hydraulic conductivity (Ksat)–double ring infiltrometer (Fig. 4) and core method.
- Bulk density- Core method at 7.6 & 15.2 cm depths.
- Volumetric water content (Θ_v)- Core method to 7.6 & 15.2 cm depths.
- Soil hardness- Clegg Impact Soil Tester (CIST) with 2.25 kg missile. Average of three independent drops. Mean G_{max} values adjusted for Θ_v.
- Soil strength- Five measurements with penetrometer (Spectrum FieldScout SC 900 Soil Compaction Meter) to 15.2 cm depth.

Data Analysis: Results were analyzed using ANOVA with an α =0.05.

Table 1. Clegg Impact Soil Tester (G_{max}) values pre- or post –fraise mowing at three locations. Means were separated using Fisher's protected Least Significant Difference (LSD) procedure at $p \leq 0.05$.

	Kenan		Navy 2016		Navy 2017	
Games	Pre-Fraise	Post-Fraise	Pre-Fraise	Post-Fraise	Pre-Fraise	Post-Fraise
0	64.0	54.0	72.9	52.0	62.0	75.0
20	65.4	55.7	83.2	51.2	70.9	77.9
40	65.7	56.8	91.5	54.0	-	-
60	-	-	-	-	71.4	79.8
LSD	3.7	5.9	3.4	4.4	3.6	5.2

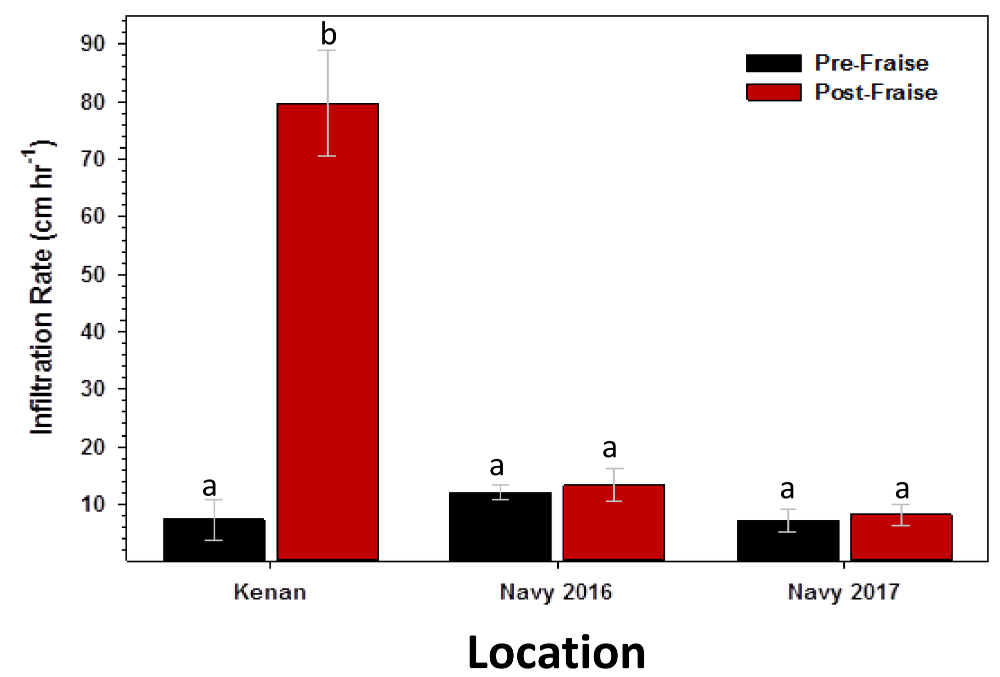


Fig. 5. Saturated hydraulic conductivity (Ksat) in cm hr^{-1} of 15.2 cm cores pre- and post-fraise mowing at all locations. Standard error bars are shown for each treatment mean, and values with the same letter across sampling time are not significantly different.

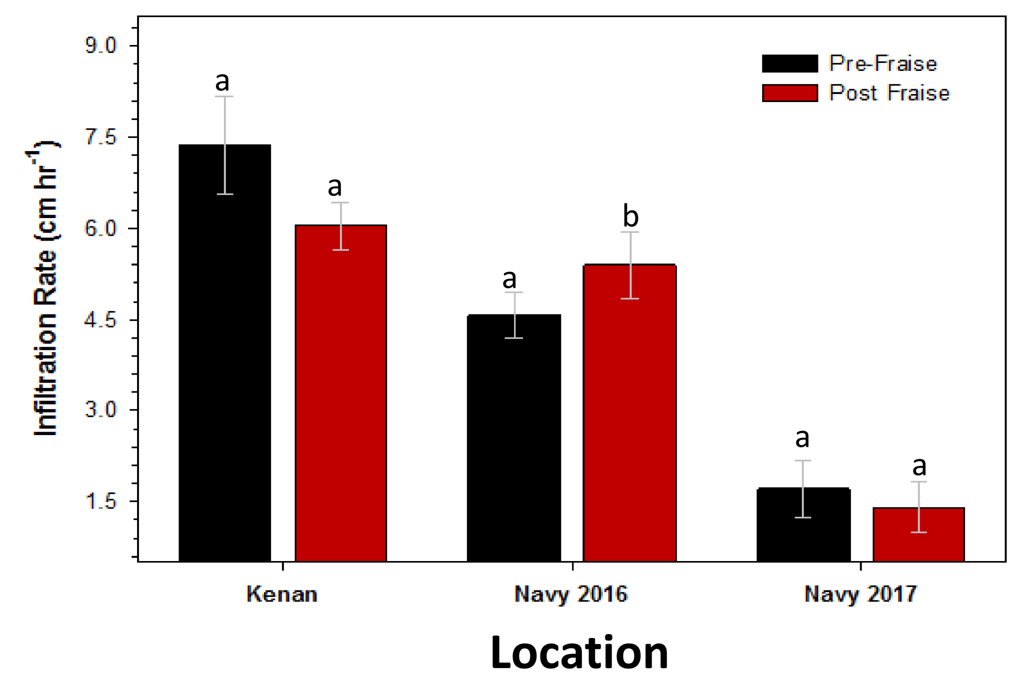
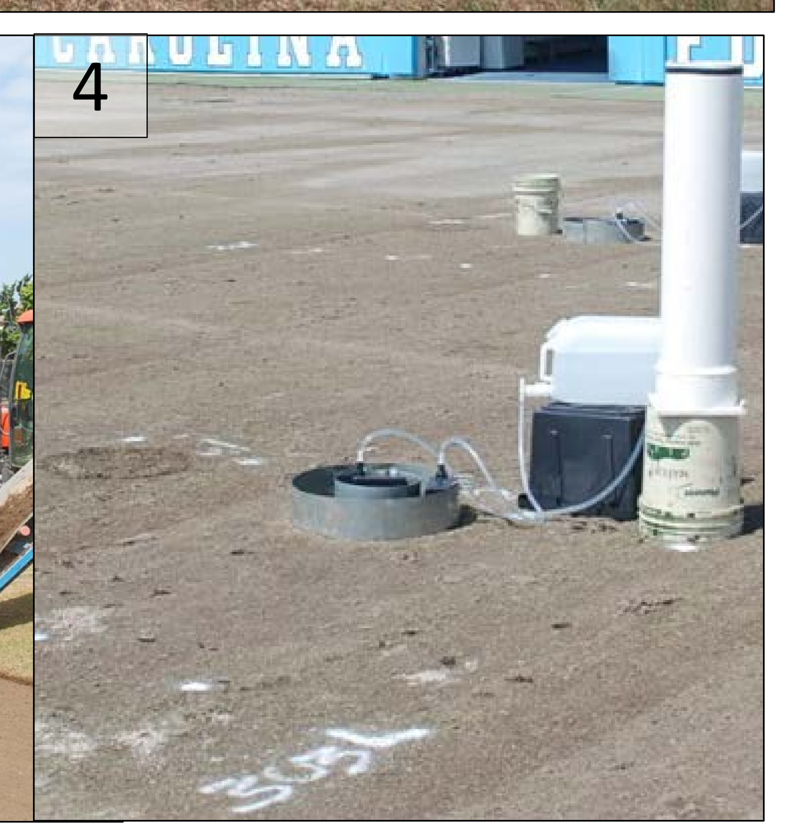


Fig. 6. *In situ* saturated hydraulic conductivity (Ksat)) in cm hr^{-1} pre- and post- fraise mowing at all locations with double ring infiltrometer. Standard error bars are shown for each treatment mean. Values with the same letter across sampling time are not significantly different.



Results and Discussion

- Fraise mowing improved Ksat (cm hr^{-1}) and reduced soil hardness (lower G_{max}) in 2016 at both fields.
- No differences in bulk density were observed following fraise mowing at any location.
- Kenan's laboratory Ksat values across all treatments were greater following fraise mowing. At time of traffic initiation, laboratory KSAT values were <7 cm hr^{-1} but improved to > 62 cm hr^{-1} following fraise mowing (Fig. 5).
- Kenan's soil hardness was reduced following fraise mowing (Table 1). Values of 5.4 to 5.6 G_{max} were seen following fraise mowing whereas values measuring above 6 G_{max} were measured before fraise mowing.
- At Navy in 2016, Ksat values improved following fraise mowing with both field and laboratory methods (Fig. 5 & 6).
- Navy's soil hardness values increased with the number of games simulated, and all treatments had values >7 G_{max}. All treatments had similar hardness values (< 5.5 G_{max}) after fraise mowing (Table 1).
- Navy's higher soil hardness values in 2017 coincided with more traffic. Post fraise mowing, all treatments had higher soil hardness values, which may be attributed to their lower gravimetric water contents.

Conclusion

Across three locations, fraise mowing's ability to relieve shallow compaction was promising. Fraise mowing improved the KSAT and decreased soil hardness at both locations in 2016, which are both markers of reduced soil compaction.

Figure 3. Trafficked treatments with respective number of games (passes) 6 days after simulated traffic .

Figure 4. Traffic simulator.

Figure 5. Fraise mowing at 1.9 cm after simulated traffic.

Figure 6. Double ring infiltrometers on post-fraise mowed plots.

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