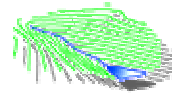




Sustainable Export of Manure Nutrients in Turfgrass Sod

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Abstract

Texas has developed a TMDL for P in segments of the Upper North Bosque River (UNBR) which includes a mandate for a 50% reduction of soluble reactive P loading. The watershed's primary agricultural activity is dairy production and large quantities of manure are produced. One suggested Best Management Practice (BMP) is the export of P through turfgrass sod produced with composted dairy manure from the impaired watershed to another receiving watershed. The transplanted sod could reduce P fertilizer applications on receiving watersheds. Simultaneous studies are being used to demonstrate the effectiveness of this BMP. Field and plot studies are finding the efficiency of turfgrass P removal. Soil and Water Assessment Tool (SWAT) modeling of the UNBR watershed along with an urban receiving watershed, Mary's Creek are utilizing the field research to further show the usefulness of the BMP. Initial results show that 46 to 77% of applied manure P can be removed in a single sod harvest. Also, sod grown with manure P rates of 190 kg P ha⁻¹ can be imported without increasing runoff losses of total dissolved P to the importing watershed. The SWAT model has successfully been calibrated to simulate the historical flow and sediment in the UNBR and the Mary's Creek watersheds. The Nash-Sutcliffe model fit efficiencies are 0.86 for flow and 0.89 for sediment in the UNBR model and 0.69 for flow in the Mary's Creek watershed.

Proposed BMP Analysis

In 2001, the State of Texas recommended a 50% reduction of soluble P to the UNBR (SAD, 2001). One new suggested BMP for P reduction in the UNBR watershed is the use of commercial turfgrass sod production supplemented with composted dairy manure to export manure nutrients in the soil sod layer. Soil and P could be harvested and exported out of the impaired watershed in a sustainable manner.

Recent research indicates:

- Approximately 46 to 77% of applied manure P can be removed in a single sod harvest (Vietor et al., 2002).
- Sod grown with manure P rates of 190 kg P ha⁻¹ can be imported without increasing runoff losses of total dissolved P compared to turfgrass sod grown and established with traditional fertilizer P rates (Vietor et al., 2004).
- Enough suitable sites for turfgrass production exist in the UNBR watershed to export all of the annual manure P excreted by the dairy cows in the county (Hanzlik, 2003).
- The SWAT model can be used successfully to model the UNBR and Mary's Creek watersheds for flow and sediment (Richards et al., 2003, Stewart et al., 2003).

The objective of this research is to demonstrate the effectiveness of the turfgrass BMP in the UNBR watershed and the effects on the receiving watershed.

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Turfgrass Production and Research

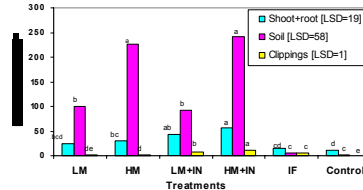
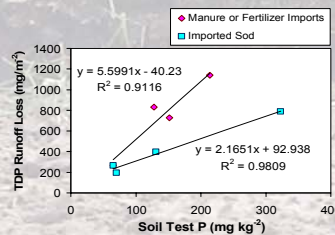


Fig. 1. Mean P mass in clippings and plant and soil components of a single sod harvest of Reveille Bluegrass on Upper North Bosque River Watershed. Composted dairy manure provided 163 (LM or LM+N) and 327 (HM or HM+N) kg P ha⁻¹ for sod production. Inorganic fertilizer N (IN) (150 kg ha⁻¹) supplemented manure N of two treatments and provided N for sod produced with fertilizer (IF).



Fig. 2. Mean mass of total dissolve P in runoff summed over 9 rain events during turf establishment. The slope of soil-test P versus P loss was 2 times greater for newly-sprigged bermudagrass topdressed with composted manure or fertilizer (dashed line) than for bermudagrass sod (solid line) transplanted from fields produced with inorganic or manure P sources. The percentage of manure P in imported sod that was lost in runoff was 33% of runoff P loss from manure P topdressed on newly-sprigged bermudagrass. Sod grown with manure P rates of 190 kg P ha⁻¹ can be imported without increasing runoff losses of total dissolved P compared to turfgrass sod grown and established with traditional fertilizer P rates.



On-going Field Research:

Comparative Tifway Bermudagrass Fields (with and without manure)

- Runoff water quality
- Turfgrass quality

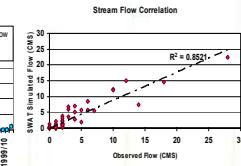
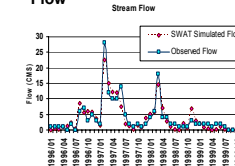
Plot-scale research to quantify turfgrass BMP effectiveness:

- Variable application rates
- Variable slope
- Variable Soils

Watershed Modeling Research

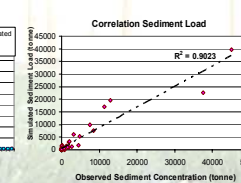
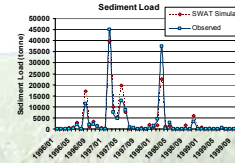
Upper North Bosque River

Flow



Flow Calibration
E(NS)= 0.86
R²= 0.86

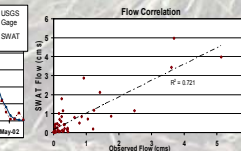
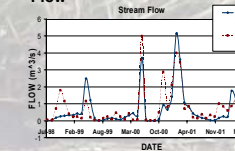
Sediment



Sediment Load
E(NS)= 0.89
R²= 0.90

Mary's Creek

Flow



Flow Calibration
E(NS)= 0.69
R²= 0.72

Sediment

Total Sediment Yield Within 0.2% of Calculated Observed



Conclusion

The initial results of the field and modeling research demonstrate that the success of the proposed BMP is highly probable. The field research illustrates that export of manure phosphorus through turfgrass production can be an efficient method to utilize the excess manure from overloaded watersheds. The results of the field research concerning manure and soil properties as well as the manure export methods of the sod are being used in the SWAT model. Calibration of the two SWAT models for flow and sediment was successful and shows that SWAT may be used to reinforce research supporting the BMP.