Bermudagrass Productivity and Soil Quality in the Southern Piedmont

USDA ARS

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Rationale

Impacts of above-ground activity on below-ground processes

Becoming known

Little known

Forages are an integral part of the agricultural landscape in the southeastern USA.

Land cover (%) in the Southern Piedmont

Forest	59
Urban/road	13
Pasture	12
Crops	9
Water/other	8

Objective

Determine animal, plant, and soil responses to fertilization source and harvest management during five years of 'Coastal' bermudagrass growth.

Methods

15-ha tract of land

On previously degraded cropland

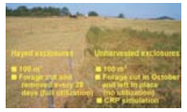
5-year evaluation

Treatments (3 x 4 factorial) in 3 replications

Actual forage mass during the 5 years.

High 4.5 ± 1.6
Low 2.5 ± 1.1

Grazed paddocks



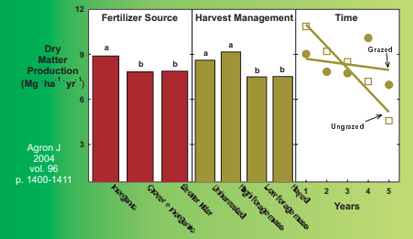
Hayed and unharvested exclosures

Response variables
Productivity (forage, animal)
Soil compaction (bulk density)
Soil fertility (N, P, K)
Soil carbon sequestration
Environmental quality (profile N, trace elements)

Productivity Results

Research to sustain agriculture and protect the environment

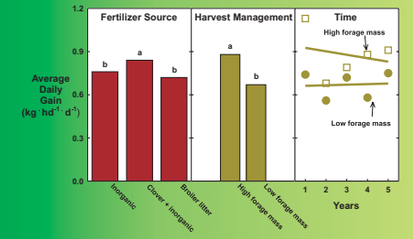
Forage production



Agron J 2004 vol. 96 p. 1400-1411

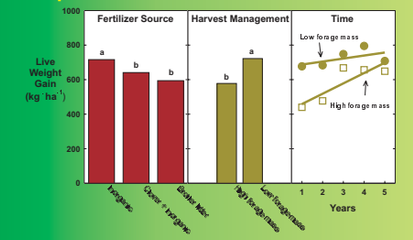
Forage production was greatest with the inorganic source, due to immediate availability.
Reducing leaf area with frequent and drastic removal reduced productivity potential.
Grazed systems became more productive with time than ungrazed systems. Rainfall during May-Sep declined with time (r = -0.77), indicating water limitation in later years.

Steer performance



Steer performance was greatest with clover + inorganic fertilizer source, due possibly to high quality of cut clover in spring.
Quantity of forage available positively affected animal gain, perhaps by allowing selection of intake diet.
Performance was erratically affected with time, but always higher with high than with low forage mass.

Steer production

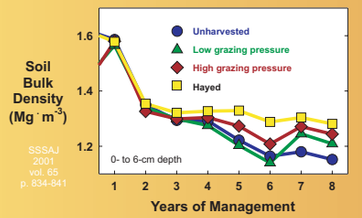


Steer production was greatest with the inorganic source, probably related to quantity of forage produced.
By grazing pasture more closely, a greater quantity of forage was consumed with a larger stocking density (5.9 vs 8.4 head/ha).
Animal gain became increasingly similar with time, probably due to more sustainable production with a better stand of forage.

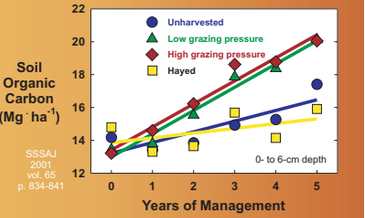
Soil Quality Results

Compaction and carbon sequestration

Soil compaction did not occur with time to any great extent with grazing compared with CRP management.
Soil carbon sequestration was greater with grazed than ungrazed management.
The rate of C sequestration with grazing was 2.2 times that of CRP and 4.8 times hayed.
Surface organic C accumulation buffered animal traffic impacts.



SSSAJ 2001 vol. 65 p. 834-841



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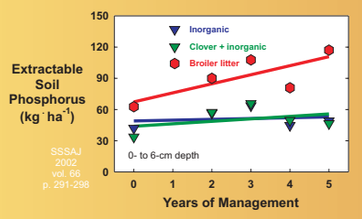
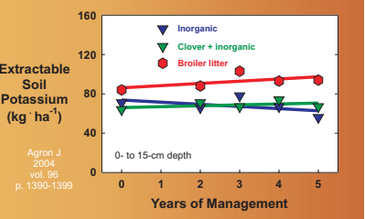
Fertility

Soil fertility was greatly improved with broiler litter application, especially with regards to P & K.
Soil pH ranged from 6.1 to 6.6 in all systems with time.
Hay harvest reduced soil K due to heavy plant demand, while soil K increased with time under grazed + broiler litter.
Soil Ca and Mg were unaffected by fertilizer source and little affected by harvest mgmt.



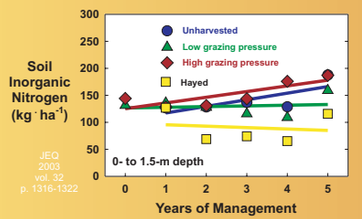
SSSAJ 2002 vol. 66 p. 291-298



Agron J 2004 vol. 96 p. 1390-1399

Potential contaminants

Potential contaminants in soil did not accumulate to a great extent.
Residual soil nitrate deep in the profile did not accumulate to a significant level. Demand for N by hay harvest reduced profile N.
Broiler litter did supply significant quantities of trace elements (i.e. Mn, Cu, & Zn).
Accumulation of soil organic C with grazing may have kept trace elements less mobile.



JEQ 2003 vol. 32 p. 1316-1322

Trace element concentration (mg/kg) in surface soil (0 to 6 cm) at the end of 5 years.

Fertilization / harvest	Mn	Cu	Zn
Inorganic	160	8	18
Broiler litter	307 *	20 *	33 *
Unharvested	246	12	27
High forage mass	228	15 *	24
Low forage mass	225	18 *	29 *
Hayed	237	10	21

J. Environ. Qual. (2003), vol. 33, p. 778-784

Bermudagrass receiving broiler litter and moderate grazing pressure was productive and improved soil quality.