# Report for 2001IA1221B: Effects of Grazing Management on Sediment and Phosphorus Losses from Pastures

There are no reported publications resulting from this project.

Report Follows:

## Problem and Research Objectives:

Because of the association of phosphorus in runoff with eutrophication of surface water sources, it is likely that the U.S. Environmental Protection Agency will implement regulations to control the Total Maximum Daily Loads (TMDLs) in watersheds within the next five years. To date, phosphorus loads in runoff from agricultural lands in the United States are poorly quantified. This is particularly true for pasturelands in the Midwest. Thus, the database for phosphorus loads that will be used to set TMDLs will likely be developed from models that rely heavily on factors like slope of the terrain. Unfortunately, these models do not consider the potential benefits of management practices like rotational or deferred grazing, regulating sward height, or hay harvest that are likely to reduce sediment losses while increasing forage production and quality. Furthermore, these models do not consider the effects of grazing management on phosphorus balance and excretion of cows. Thus, grazing could be unnecessarily be prohibited on much of the pastureland bordering 8,868 of rivers and streams in Iowa alone. Even if grazing were allowed with fencing of buffer strips, it would cost Iowa farmers nearly $37.5 million in fencing.

In order to develop a database on the relationship of grazing management and sediment and phosphorus runoff from highly erodible soils in Iowa, a project is being conducted with the objectives of:

1) Quantifying the amounts of sediment, P and N in runoff from pastures grazed with different stocking systems during the summer or managed by hay harvest during summer and stockpiled forage grazing during winter.
2) Determining the effectiveness to riparian buffer strips at controlling losses of sediment and P in surface runoff from pastures managed by different systems.
3) Quantifying the impacts of animal nutrition and forage grazing management on P balances and losses from grazing-based production systems.
4) Developing site-specific models for Comprehensive Nutrient Management Plans to control nutrient runoff from pastures through management of forage growth and harvest, animal nutrition, and grazing strategies.

## Methodology:

Three blocks of approximately 2.75 hectares along hillsides were identified within in a smooth bromegrass pasture on the Iowa State University Rhodes Research Farm. A 6-m lane was placed along the top of each block for movement of cattle between pastures. To evaluate the efficacy of buffer strips to control nutrient runoff, a 10-m buffer strip (a 10:1 pasture:buffer ratio) was located along the bottom of each block. Each block was divided into five 0.4-hectare paddocks with a 3-m buffer strip separating each paddock. To limit movement of sediment and nutrient between treatments, sandbags were placed in the fencelines between the paddocks and the lane at the above the paddocks and between different paddocks. To attain equal initial phosphorus concentrations, soils were sampled at the 0 to 5 cm and 5 to 15 cm depths, analyzed for P by the Bray 1 method, and fertilized with P to an adequate level. Prior to grazing, each paddock was fertilized with

N as ammonium-nitrate at a rate of 67 kg/ha. Waterers for stock were placed at the top of each paddock.

In each block, 5 forage management treatments were allotted to the five paddocks. One paddock was not grazed. To evaluate the effects of grazing systems on sediment and nutrient losses, one paddock in each block was grazed by 3 non-pregnant cows during summer to a sward height of 5 cm as determined with a rising plate meter (4.8 kg/m$^2$) which was maintained by a put-and-take stocking system thereafter simulating an intensively grazed continuous stocking system. Two paddocks were grazed with 3 non-pregnant cows to sward heights of 5 or 10 cm as measured with a rising plate meter. When sward heights decreased below the minimal sward height, cows were removed from that paddock and placed on an adjacent smooth bromegrass pasture to provide the paddocks with a 35-day rest period simulating rotational grazing systems with different residual forage heights. To limit the amount of additional phosphorus added to the pasture as feces and urine, cows were not supplemented with phosphorus, either while they were stocked on the experimental paddocks or on the adjacent smooth bromegrass pasture between periods of experimental grazing.

The remaining paddock in each block was used to evaluate nutrient run-off from pastures used for a management system that integrated summer hay harvest with winter stockpiled grazing. Forage from these paddocks was harvested as small bales in June. Although a second hay cutting was planned to occur in August, the amount of forage available for baling was inadequate for baling. Therefore, in August, forage in these paddocks was mowed and left in the field. All pastures were fertilized with N at 45 kg/ha as ammonium nitrate. Residual forage in paddocks assigned the hay/stockpile treatment was allowed to stockpile for late fall grazing. On November 12, each stockpiled paddock was stocked with 3 non-pregnant cows and grazed to a sward height of 5 cm on November 21.

To evaluate the effects of treatments on sediment and nutrient losses, six monitoring sites were located on two different slopes in each paddock. An additional six sites were located in the buffer strip either immediately or 10 m below the treatment paddocks. Water infiltration and sediment and phosphorus at each monitoring site were measured in June, August, and October, 2001 and in April, 2002 using 0.5 x 1.0 m drip rainfall simulators (Bowyer-Bower and Burt, 1989) with a precipitation rate of 6 cm/hr for 90 minutes.

To validate the use of rainfall simulations to predict nutrient losses from pastures, runoff from natural rainfall events was also collected in the paddocks with either no grazing or the three summer grazing treatments. In each of these paddocks, two 3 m x 24.4 m collection plots were constructed to include both the buffer and the upslope pastures using area ratios of 5:1 and 10:1. All plots were hydrologically isolated from their surroundings by sheet metal borders driven in the ground. A collector at the bottom of each plot directed runoff water to a 2.4-m diameter x 0.6 m deep collection tank. Runoff amounts were measured volumetrically after each rainfall event. Sediment concentration in runoff water was determined by oven-drying. Subsamples of runoff water are being analyzed for total phosphorus and dissolved reactive phosphate.

To measure the effects of treatments on soil and plant characteristics, soil samples, soil physical measurements and forage samples were collected adjacent to each monitoring site and within each buffer strip simultaneous to the infiltration experiments. Soil samples were collected from 0 to 5 and 5 to 15 cm depths and analyzed for the contents of moisture, total phosphorus, and soluble phosphorus. Soil penetration resistance was measured to a depth of 35 cm with a pentetrometer. Soil surface roughness was measured by image analysis of digital photographs of a 40-pin meter. Hill slope was measured with a digital level. Proportions of bare soil were measured from image analysis of digital photographs and by the point method. Forage sward height was measured with a rising plate meter (4.8 kg/$m^2$). Forage samples were hand-clipped, weighed, and analyzed for dry matter and phosphorus.

The effects of forage treatments on uptake of soil nutrients is being determined using six 1-$m^2$ grazing exclosures in each paddock. At the initiation of each month, grazing exclosures were moved to a new position within the paddock and a forage sample was clipped from a .25-$m^2$ area adjacent to the exclosure. At the end of each month, a sample was clipped from a .25-$m^2$ area within the exclosure. Simultaneously, forage samples was clipped from within the vegetative buffer strip. Forage harvested as hay was also sampled at each harvest. Forage samples were weighed, dried and are being analyzed for nitrogen and phosphorus to determine nutrient uptake and harvest by the forage plants. Root samples were collected in the fall to determine the effects of grazing management on below-ground biomass.

Simultaneous to forage sampling, soil samples were collected and are being analyzed for available phosphorus by the Bray 1 method, exchangeable potassium, calcium, magnesium, sodium, total nitrogen and total carbon so that changes in nutrient status with time can be monitored.

To evaluate the impacts of forage management on phosphorus balance within a system and phosphorus losses from a system, phosphorus balance is being determined in each cow monthly. To estimate phosphorus excretion, cows were bolused with an indigestible marker (chromic oxide) daily for 4-day adjustment and 3-day collection periods. During the collection period, fecal samples were collected and analyzed for chromium and phosphorus to determine total feces and phosphorus excretion. The concentration of in vitro digestible organic matter and phosphorus in forage consumed by grazing cows and the total fecal excretion are being to determine phosphorus intake. Phosphorus balance in the cows is being determined as the difference between the amounts of phosphorus consumed and excreted. These values along with the forage phosphorus uptake and phosphorus runoff data will be used to model phosphorus flow within the system which will be used to develop Comprehensive Nutrient Management Plans for farms with grazing enterprises.

## Principal Findings and Significance:

### Rainfall Simulations.

Paddocks that were ungrazed, harvested as hay and grazed as stockpiled forage, grazed to 5 cm by continuous stocking, and grazed to 5 or 10 cm by rotational stocking provided 0, 47, 492, 360, and 274 cow-days/ha of grazing.

Over the 4 rainfall simulation periods, the proportions of rainfall running off of simulation plots in pastures in which forages were harvested as hay and grazed as stockpiled forage or grazed were 2.66 times greater than ungrazed pastures. This difference, however, was significant only in June and August (Table 1). Over the 4 periods, the mean proportion of water runoff from pastures rotationally stocked to a residual sward height of 10 cm tended lower than pastures harvested as hay and grazed as stockpiled forage or grazed to 5 cm by continuous or rotational stocking. However, in no month was the difference in runoff significant between any of the forage harvest or grazing treatments.

Table 1. LS means of proportions of rainfall runoff from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| Pasture management | Month of rainfall simulation | | | |
|---|---|---|---|---|
| | June | April | October | August |
| | % of water applied | | | |
| Ungrazed | $21.1^{a}$ | $2.2^{a}$ | $3.1^{a}$ | $4.5^{a}$ |
| Hay/Stockpiled grazing | $45.5^{b}$ | $14.4^{b}$ | $10.5^{a}$ | $12.2^{a}$ |
| 5 cm continuous stocking | $37.8^{b}$ | $16.4^{b}$ | $24.5^{a}$ | $6.2^{a}$ |
| 5 cm rotational stocking | $43.1^{b}$ | $18.9^{b}$ | $22.4^{a}$ | $4.3^{a}$ |
| 10 cm rotational stocking | $32.3^{b}$ | $7.2^{b}$ | $16.6^{a}$ | $8.1^{a}$ |

[ab]Differences between means with different superscripts are significant.

Sediment concentrations of runoff from pastures that were ungrazed, harvested as hay or grazed by any of the summer stocking systems did not differ between treatments in June, October, or April (Table 2). However, sediment concentrations of pastures grazed by continuous or rotational stocking to 5 cm were greater than those pastures that were ungrazed, harvested as hay or grazed by rotational stocking to 10 cm. Annual sediment flows, calculated as the sum of measurements during the four rainfall simulation periods, of ungrazed pastures were 22% of pastures in which forage was harvested as hay and grazed as stockpiled forage in November or grazed by any of the stocking systems during summer. But there was no difference in sediment flow from pastures harvested by hay or grazed by any of the stocking systems.

Concentrations of total P in runoff in June from pastures grazed by continuous or rotational stocking to 5 or 10 cm were greater than paddocks that were ungrazed or harvested as hay (Table 3). However, there was no difference between treatments in the concentrations of total P in the runoff in August, October, or April. Annual flows of total P, calculated as the sum of measurements during the four rainfall simulation periods, from ungrazed pastures were 18% of pastures in which forage was harvested as hay and grazed as stockpiled forage in November or grazed during summer. Total P flows did not

Table 2. LS means of sediment concentrations and flows from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| | Month of rainfall simulation | | | | |
|---|---|---|---|---|---|
| Pasture management | June | August | October | April | Total annual |
| | Sediment concentration, g/L | | | | |
| Ungrazed | .05[a] | .01[a] | .01[a] | .02[a] | |
| Hay/ Stockpiled grazing | .05[a] | .02[a] | .01[a] | .02[a] | |
| 5 cm continuous stocking | .08[a] | .16[b] | .04[a] | .03[a] | |
| 5 cm rotational stocking | .06[a] | .41[b] | .05[a] | .05[a] | |
| 10 cm rotational stocking | .05[a] | .03[a] | .02[a] | .10[a] | |
| | Sediment flow, kg/ha | | | | |
| Ungrazed | 10.0[a] | .6[a] | .6[a] | .3[a] | 11.5[a] |
| Hay/ Stockpiled grazing | 28.1[a] | 4.3[a] | .4[a] | 1.3[a] | 34.1[b] |
| 5 cm continuous stocking | 37.9[a] | 9.3[a] | 13.5[a] | 2.0[a] | 62.8[b] |
| 5 cm rotational stocking | 37.3[a] | 19.5[a] | 8.9[a] | 1.9[a] | 67.6[b] |
| 10 cm rotational stocking | 21.6[a] | 8.5[a] | 3.9[a] | 9.7[b] | 43.7[b] |

Table 3. LS means of total P concentrations and flows from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| | Month of rainfall simulation | | | | |
|---|---|---|---|---|---|
| Pasture management | June | August | October | April | Total annual |
| | | | Total P concentration, mg/L | | |
| Ungrazed | .17[a] | .13[a] | .01[a] | .19[a] | |
| Hay/ Stockpiled grazing | .23[a] | .24[a] | .04[a] | .21[a] | |
| 5 cm continuous stocking | .35[b] | .52[a] | .37[a] | .12[a] | |
| 5 cm rotational stocking | .40[b] | .48[a] | .40[a] | .19[a] | |
| 10 cm rotational stocking | .39[b] | .10[a] | .56[a] | .27[a] | |
| | | | Total P flow, kg/ha | | |
| Ungrazed | .03[a] | .01[a] | 0[a] | .01[a] | .05[a] |
| Hay/ Stockpiled grazing | .12[b] | .04[a] | .01[a] | .03[a] | .21[b] |
| 5 cm continuous stocking | .12[b] | .12[b] | .06[a] | .01[a] | .33[b] |
| 5 cm rotational stocking | .22[b] | .09[b] | .04[a] | .01[a] | .37[b] |
| 10 cm rotational stocking | .16[b] | .03[a] | .03[a] | .03[a] | .26[b] |

differ between pastures harvested as hay and grazed as stockpiled forage or grazed by continuous or rotational stocking at 5 or 10 cm.

Because an average of 85.4% of the total P was soluble P, most trends in soluble P followed were similar to those of total P. Concentrations of soluble P in paddocks grazed to 5 cm by either continuous or rotational grazing were greater than ungrazed paddocks in June, August, and October (Table 4). Similarly, concentrations of soluble P were greater in paddocks grazed by rotational stocking to 10 cm than ungrazed paddocks in June and October and greater in paddocks harvested as hay than ungrazed paddocks in August. As a result, the annual flow of soluble P were greater in paddocks grazed to 5 cm by continuous or rotational stocking than in paddocks under the other forage management systems.  In addition, the annual flow of soluble P were greater in paddocks harvested for hay and grazed as stockpiled forage or grazed to 10 cm by rotational stocking than ungrazed paddocks.

Table 4.  LS means of soluble P concentrations and flows from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| | Month of rainfall simulation | | | | |
|---|---|---|---|---|---|
| Pasture management | June | August | October | April | Total annual |
| | | | Soluble P concentration, mg/L | | |
| Ungrazed | .14$^{a}$ | .12$^{a}$ | .01$^{a}$ | .11$^{a}$ | |
| Hay/ Stockpiled grazing | .23$^{a}$ | .22$^{b}$ | .04$^{ab}$ | .09$^{a}$ | |
| 5 cm continuous stocking | .36$^{b}$ | .35$^{c}$ | .27$^{b}$ | .04$^{a}$ | |
| 5 cm rotational stocking | .44$^{b}$ | .34$^{c}$ | .16$^{b}$ | .03$^{a}$ | |
| 10 cm rotational stocking | .39$^{b}$ | .05$^{a}$ | .21$^{b}$ | .07$^{a}$ | |
| | | | Soluble P flow, kg/ha | | |
| Ungrazed | .02$^{a}$ | .01$^{a}$ | 0$^{a}$ | .01$^{a}$ | .04$^{a}$ |
| | .12$^{a}$ | .04$^{a}$ | .01$^{a}$ | .01$^{a}$ | .19$^{b}$ |
| 5 cm continuous stocking | .17$^{b}$ | .08$^{b}$ | .04$^{a}$ | .01$^{a}$ | .30$^{c}$ |
| 5 cm rotational stocking | .27$^{b}$ | .08$^{b}$ | .01$^{a}$ | 0$^{a}$ | .36$^{c}$ |
| 10 cm rotational stocking | .15$^{b}$ | .02$^{ab}$ | .02$^{a}$ | .02$^{a}$ | .21$^{b}$ |

As designed, the forage masses, estimated by sward height or clipping, were greater in ungrazed paddocks than paddocks in which the forage was harvested as hay or grazing in all months and were greater in paddocks grazed to 5 cm by continuous stocking in August and October than paddocks harvested as hay and grazed as stockpiled forage or grazed to 10 cm by rotational stocking (Table 5).  Although both were grazed to a sward height of 5 cm, paddocks by rotational stocking to 5 cm had greater sward heights

Table 5. LS means of sward heights, forage masses and surface covers from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| Pasture management | Month of rainfall simulation | | | |
|---|---|---|---|---|
| | June | April | October | August |
| | | Sward height, cm | | |
| Ungrazed | $23^{a}$ | $16.1^{a}$ | $11.2^{a}$ | $7.6^{a}$ |
| Hay/Stockpiled grazing | $9.8^{b}$ | $9.3^{b}$ | $10.9^{b}$ | $6.8^{ab}$ |
| 5 cm continuous stocking | $12.1^{b}$ | $5.3^{c}$ | $3.7^{c}$ | $4.2^{b}$ |
| 5 cm rotational stocking | $10.5^{b}$ | $7.6^{b}$ | $5.3^{cb}$ | $5.3^{b}$ |
| 10 cm rotational stocking | $13.0^{b}$ | $10.3^{b}$ | $7.8^{b}$ | $6.4^{ab}$ |
| | | Forage mass, kg DM/ha | | |
| Ungrazed | $3663^{a}$ | $4659^{a}$ | $3870^{a}$ | $2856^{a}$ |
| Hay/Stockpiled grazing | $852^{b}$ | $1392^{b}$ | $2157^{b}$ | $1736^{b}$ |
| 5 cm continuous stocking | $2111^{b}$ | $1099^{c}$ | $960^{c}$ | $961^{b}$ |
| 5 cm rotational stocking | $1840^{b}$ | $1521^{b}$ | $1439^{d}$ | $1170^{b}$ |
| 10 cm rotational stocking | $2098^{b}$ | $1992^{b}$ | $1841^{d}$ | $1833^{b}$ |
| | | Surface cover, % | | |
| Ungrazed | - | $98.0^{a}$ | - | $100.0^{a}$ |
| Hay/Stockpiled grazing | - | $91.5^{b}$ | - | $95.5^{b}$ |
| 5 cm continuous stocking | - | $77.8^{c}$ | - | $87.8^{c}$ |
| 5 cm rotational stocking | - | $86.0^{b}$ | - | $94.0^{b}$ |
| 10 cm rotational stocking | - | $92.1^{b}$ | - | $94.0^{b}$ |

August and greater clipped forage masses in August and October than paddocks grazed by continuous stocking to 5 cm. There were no differences between paddocks grazed by rotational stocking to 10 cm and those harvested for hay and grazed as stockpiled forage for sward height in any month or clipped forage mass in June, August, or April. Similar to sward height and forage mass, surface covers in August and April were greater in paddocks that were ungrazed than paddocks in which forage were harvested. Furthermore, surface covers of paddocks harvested as hay and grazed as stockpiled forage or grazed by rotational stocking to 5 and 10 cm sward heights than paddocks grazed by continuous stocking to 5 cm.

Surface roughness measured with a 40-pin meter did not differ between paddocks that were not grazed or in those in which the forage was harvested by hay harvest or grazing in June, August or October (Table 6). In contrast, penetration resistances were lower in ungrazed paddocks than paddocks which were harvested as hay and grazed as stockpiled forage, grazed by continuous stocking to 5 cm or grazed by rotational stocking to 5 or 10 cm in the upper 10.5 cm of soil in October and April and in the 10.5 to 21 cm depth in April. However, there were no differences in penetration resistance in paddocks in which hay was harvested or grazed by continuous or rotational stocking.

Table 6.  LS means of surface roughness and penetration resistance of soils from pastures that were ungrazed, harvested as hay and grazed as stockpiled forage in November, grazed by continuous stocking to a sward height of 5 cm or grazed by rotational stocking to a sward height of 5 or 10 cm.

| Pasture management | Month of rainfall simulation | | | |
|---|---|---|---|---|
| | June | April | October | August |
| | Standard deviations of 40 pins, cm | | | |
| Ungrazed | $.61^{a}$ | $.67^{a}$ | $.79^{a}$ | - |
| Hay/Stockpiled grazing | $.59^{a}$ | $.80^{a}$ | $.68^{a}$ | - |
| 5 cm continuous stocking | $.69^{a}$ | $.75^{a}$ | $.71^{a}$ | - |
| 5 cm rotational stocking | $.63^{a}$ | $.75^{a}$ | $.75^{a}$ | |
| 10 cm rotational stocking | $.68^{a}$ | $.83^{a}$ | $.78^{a}$ | - |
| | Penetration resistance, kgf<br>0 – 10.5 cm | | | |
| Ungrazed | $15.3^{a}$ | $31.0^{a}$ | $21.8^{a}$ | $14.0^{a}$ |
| Hay/Stockpiled grazing | $13.6^{a}$ | $34.0^{b}$ | $25.8^{ab}$ | $20.4^{b}$ |
| 5 cm continuous stocking | $14.9^{a}$ | $35.5^{b}$ | $28.7^{b}$ | $20.5^{b}$ |
| 5 cm rotational stocking | $14.1^{a}$ | $42.1^{b}$ | $27.7^{b}$ | $20.4^{b}$ |
| 10 cm rotational stocking | $16.9^{a}$ | $38.8^{b}$ | $29.9^{b}$ | $19.2^{b}$ |
| | 10.5 – 21.0 cm | | | |
| Ungrazed | $20.2^{a}$ | $34.7^{a}$ | $25.7^{a}$ | $19.2^{a}$ |
| Hay/Stockpiled grazing | $18.2^{a}$ | $36.9^{a}$ | $29.9^{a}$ | $23.2^{b}$ |
| 5 cm continuous stocking | $20.3^{a}$ | $35.2^{a}$ | $28.1^{a}$ | $22.8^{b}$ |
| 5 cm rotational stocking | $18.2^{a}$ | $43.1^{a}$ | $27.6^{a}$ | $21.9^{b}$ |
| 10 cm rotational stocking | $20.5^{a}$ | $20.5^{a}$ | $30.7^{a}$ | $22.0^{b}$ |

Runoff plots. Preliminary results of the amount of surface runoff, and sediment and $PO_4$-P concentrations in runoff from all treatment plots for the natural rainfall events from July 2001 to October 2001 are presented in Figures 1 and 2. These figures show some mixed results for the amount of runoff and sediment yield in the early rainfall events (Figure 1a-1c). Treatment effects are not very visible in the earlier part of the year. However, Figure 1d shows some grazing/buffer treatments effects more prominently on surface runoff and sediment concentration during the rainfall event on the 22$^{nd}$ of October 2001. Figure 1 also shows that the continuous grazing treatment had highest runoff and sediment concentrations. Figure 2 also depicts some treatment effects on $PO_4$-P concentrations with surface runoff. Phosphorus concentrations with runoff were found to be highest under continuous grazing system. Although this was the first year of the study, the preliminary data showed the effects of various grazing systems and management practices on the losses of sediment and nutrients with surface runoff.

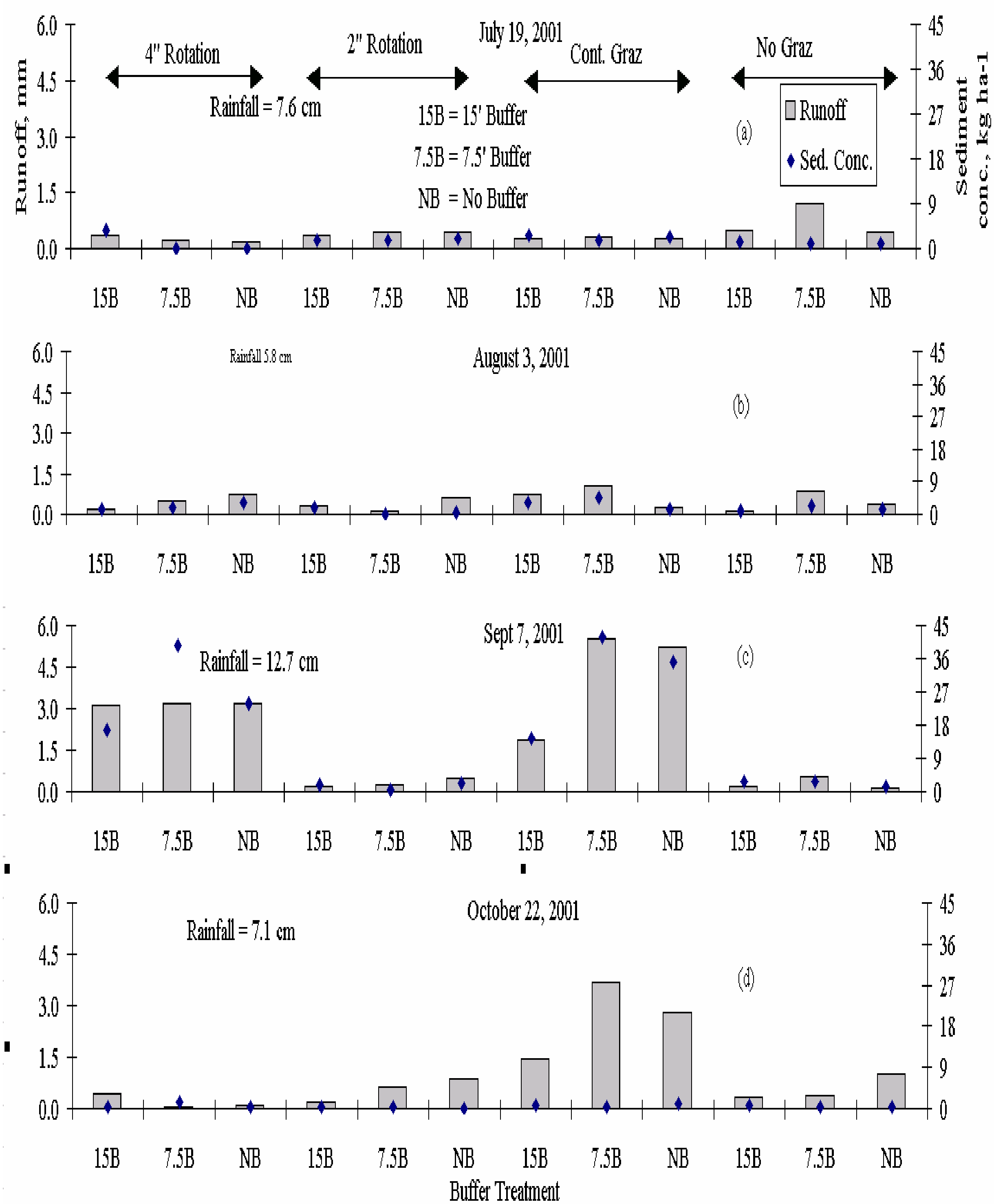


Figure 1. Amount of surface runoff and sediment in runoff water for the natural rainfall events during 2001.

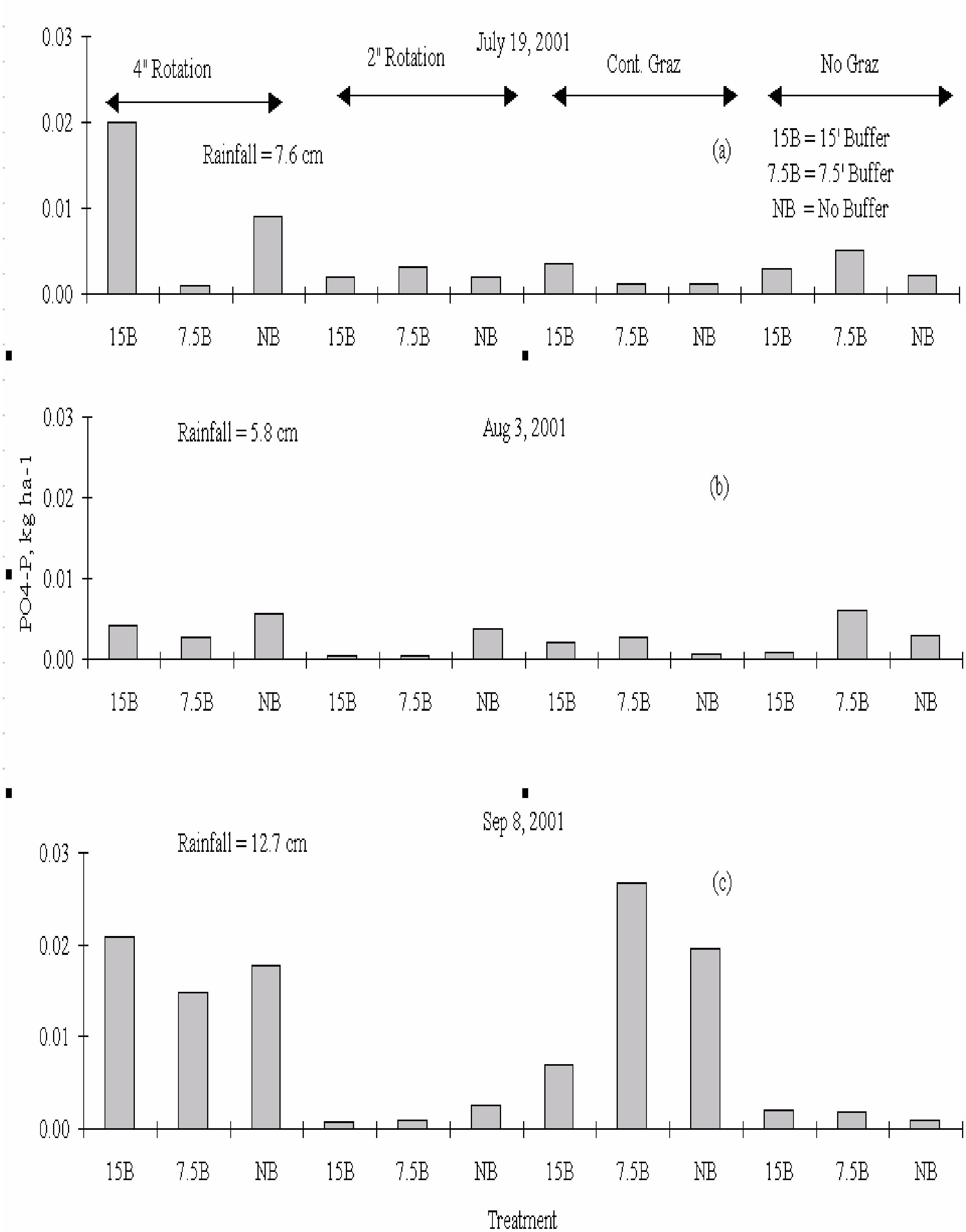


Figure 2. Amount of PO4-P in surface runoff for the natural rainfall events during 2001.

Soil and root sampling. Total P content of the soil samples collected May 7, 2001 was analyzed following digestion using the Aqua Regia ($H_2SO_4$ + $HNO_3$) method. Total P in the surface (0-5 cm) layer ranged from 337 to 526 ppm in the 15 paddocks. The buffer area totals ranged from 175 to 436, slightly lower than the paddocks (Table 7).

Table 7. Mean total P content of surface soils (0-5 cm layer) within paddocks and buffer areas of each grazing treatment.

| Treatment | Total P, ppm | |
|---|---|---|
| | Paddock | Buffer |
| Control | 475 | 332 |
| Hay/Stockpile | 374 | 255 |
| 4” Rotational | 451 | 323 |
| 2” Continuous | 429 | 293 |
| 2” Rotational | 449 | 309 |

Soil core samples collected June 21, 2001 for initial root length density were processed using a hydropneumatic root separation system. The samples were processed further to remove plant residues and debris. Root length will be determined by scanned images of each sample. Mean root length density will then be calculated for each of the treatment areas.

Whole-farm phosphorus flow estimates.

Monthly throughout the summer of 2001, cows were dosed with chromic oxide and forage and fecal samples were collected for the determination of dry matter and phosphorus intake. Samples were currently being analyzed.

Significance of preliminary results.

Preliminary results imply that harvest of forage either by hay harvest or grazing increases rainfall run-off and losses of sediment, total P and soluble P. These losses tend to be greater when forage is grazed to a residual height of 5 cm by either continuous or rotational stocking than when forage is grazed to a residual sward height of 10 cm or forage is harvested as hay. The greater losses with greater intensity of grazing seem related to the shorter sward heights, lower forage masses, lower canopy cover and greater soil penetration resistance in the upper 10.5 cm of soil which occur compared to no grazing, hay harvest, or grazing to a residual sward heights of 10 cm.