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Contents

Research Article

- 102 **Effects of Simulated Wintertime Flooding to Control Erosion on Selected Chemical and Microbial Properties of Agricultural Soils in the Mississippi Delta—Clifford A. Ochs and Scott A. Milburn**

Brief Communications

- 115 **The occurrence of *Fusarium merismoides* var. *chlamydosporale* (Tuberculariaceae), in Rankin County, Mississippi—George H. Dukes, Jr., Gerald M. McGuire II, Dionne Jackson, and Sarah Lea McGuire**
- 117 **First Report of Crazy Top in Mississippi River Delta Corn (*Zea mays*)—H.K. Abbas and H.A. Bruns**

Departments

- 98 **Editorial—Ken Curry**
- 100 **Photographs of the Annual Meeting—Ann Curry**
- 119 **President's Column—Robert C. Bateman, Jr.**
- 119 **Executive Officer's Column—John Boyle**
- 120 **Divisional Reports**
- 125 **2003 Annual Meeting Abstracts (supplement)**

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Editorial

Another era in the history of the Mississippi Academy of Sciences has come to a close and a new era is dawning as John Boyle steps down as executive officer after 13 years and Charles Swann moves into that position. The title of executive officer does not sound as prestigious as president, but John saw 13 presidents come and go. In fact each executive officer sees a number of presidents pass through the office while the executive officer guides the academy year by year tending to its financial well being, and advising and handling an increasing number of aspects of academy business as the experience of that officer increases. The history of the academy that was published several years ago contained a list of presidents, but no list of executive officers.

My association with the academy began just before the previous executive officer, Dudley Peeler, turned the reins over to John Boyle. I have seen John guide the academy throughout his tenure, helping each president as his own experience grew. My observations from the sidelines have prompted me to point to the importance of that office. I hope the next history of the academy gives the executive officers the acknowledgment they deserve. The executive officer is the heart and the continuity of our academy.—Ken Curry

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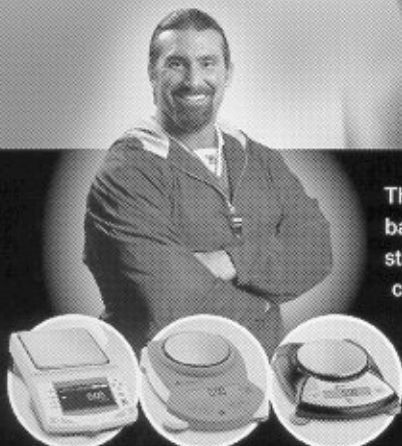
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Sixty-Seventh Annual Meeting of the Mississippi Academy of Sciences

(more photographs appear with the division reports)

Junior Academy of Sciences. Soumo De (left) and Vignesh Shettar (right) tied for the 2nd place award given by Amiée T. Lee

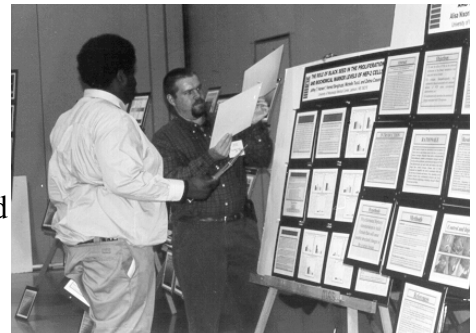


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Effects of Simulated Wintertime Flooding to Control Erosion on Selected Chemical and Microbial Properties of Agricultural Soils in the Mississippi Delta

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Between late fall and early spring in the Mississippi Delta agricultural region (the floodplain between the Mississippi and Yazoo Rivers in the state of Mississippi, USA), agricultural fields are typically without plant cover, precipitation is high, and losses by erosion of soil and associated agrochemicals can be severe. To control erosion, some farmers in this region allow their fields to flood during winter with rain or river water. We evaluated the effects of simulated wintertime flooding of Mississippi Delta soybean and cotton field soils during winter on several aspects of soil chemistry, the chemistry of overlying water, and soil microbial abundances, biomass, and metabolic activity. During a 77-day period of flooding, concentrations of soil $\text{NH}_4\text{-N}$ were up to five times higher and $\text{NO}_3\text{-N}$ three times lower in flooded compared to non-flooded soils. Eighteen days after drainage, however, there were no significant differences in soil chemistry between previously flooded and non-flooded soils. Although we detected no differences in denitrification or soil respiration rates during flooding, following drainage the denitrification rate averaged $37 \text{ mg N}_2\text{O-N ha}^{-1} \text{ day}^{-1}$ in previously flooded cotton field soils, but was undetectable in previously non-flooded soils. Relative to soil pools, minor amounts ($< 0.3\%$) of nitrogen or carbon were lost from the soils during flooding by either denitrification or soil respiration. No detrimental effects on agricultural soil properties of managed wintertime flooding were detected, however, as this was a short-term study and not all important properties of the soils were examined, additional study is recommended before this practice is adopted widely.

Keywords: agricultural soils, flooding, wetlands, biogeochemistry

Since the first half of the last century, intensively farmed land has contributed to a doubling of nutrients entering the Mississippi River (Turner and Rabalais 1994), from which it is estimated that over 330 million tons of soil enters the Gulf of Mexico annually (Cooper 1993). Erosion is also responsible for the translocation of agrochemicals (nutrients and pesticides) into area waters (Douglas et al. 1998; Sharpley et al. 1995). Eutrophication (Carpenter et al. 1998) resulting from nutrient pollution is associated with poor water quality (Christie and Smol 1996), toxic algal blooms (Burkholder 1998), oxygen depletion (Lowery 1998), fish kills (Burkholder and Glasgow 1997), and loss in biodiversity (Xie et al. 1996). Soil erosion is a leading factor in reduced soil fertility in agricultural systems in the U.S. (Pimental

et al. 1995), and can negatively impact crop yields (Dormaar et al. 1997; Syers 1997; Pimental et al. 1995). With reduction of soil erosion and loading of chemicals from agricultural fields and other sources into aquatic ecosystems, some of these problems can be minimized or reversed (Edmondson and Lehman 1981).

In the southeastern United States the greatest loss of soil from agricultural fields occurs during the non-growing season coincident with high rates of precipitation and a lack of plant cover. Of increasing interest in the Mississippi Delta agricultural region (the floodplain of the Mississippi and Yazoo Rivers) is an approach to reduce erosion by intentional, managed flooding of fields during the non-growing season. Agricultural soils in the Mississippi Delta often are

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high in clay and silt, and if surface runoff is prevented, the field will flood. To facilitate flooding, state and federal agencies have assisted in the installation of slotted-board risers in some cotton and soybean fields. These structures are a barrier to surface flow, sustaining a specific water level on the field, and reducing erosion by protecting the soil from disturbance by additional rain (Green 1998). Secondary benefits include creation of habitat for migrating waterfowl (Maul and Cooper 1998), and possible suppression of soil pathogens. Potentially detrimental effects include alteration of biogeochemical cycles leading to reduced soil fertility or mobilization of toxic chemical compounds, and disturbance or extirpation of normal soil microbial and animal communities.

The biogeochemistry of nitrogen under flooded soils was of particular interest to us, because N limits agricultural production in the Mississippi Delta, and may limit algal production in the Gulf of Mexico into which the Mississippi flows (Walsh et al. 1981; Lovejoy 1992). The mechanisms and extent of N export from flooded fields have strikingly different consequences for environmental quality. If nitrification is significant, $\text{NO}_3\text{-N}$ could enter the overlying water column or ground water, resulting in high concentrations of dissolved N exported from the fields by percolation or during drainage. If N is primarily removed by denitrification, however, the problem of N pollution of aquatic ecosystems is reduced. Denitrification from temporally flooded agricultural fields as well as wetlands can be an important vector for N export (Groffman 1994; Davidson 1992). Bacon et al. (1986), for example, reported that $\text{NO}_3\text{-N}$ concentrations fell by 90% during intermittent flood irrigations of rice fields, and that most of this loss was due to denitrification. If export rates are substantial by any mechanism, such as runoff, percolation or denitrification, long-term soil fertility could be compromised (Reddy et al. 1989). Conversely, the net result of flooding may be to reduce N losses in runoff from exposed soils, or even to increase soil N concentration by providing waterfowl habitat (Maul and Cooper 1998).

Phosphorus may also limit primary production, especially in aquatic environments. Where there is oxygen, inorganic P occurs predominately in a particulate form (Mitsch and Gosselink 1993). In anoxic conditions, however, inorganic P compounds are released in a soluble form (Wetzel 2001). Thus, temporary flooding potentially could promote solubilization and diffusion of soil P, reducing soil

concentrations and promoting downstream eutrophication.

This research was designed to address the following hypotheses, all of which are based on the premise that flooding will reduce soil oxygen concentration:

1. Flooding will decrease rates of nitrification, microbial respiration and organic matter decomposition.
2. Flooding will enhance rates of denitrification.
3. Flooding will promote movement (by solubilization, desorption and diffusion) of C, N, and P chemical species from the soil layer into the overlying water column.

To address these questions, an experiment was conducted in which we simulated wintertime flooding of soils from a series of cotton and soybean fields in the Mississippi Delta. Over the course of a 96-day incubation, the soils were analyzed for concentrations of various species of nitrogen, organic carbon, and total phosphorus. Additionally, we examined microbial community properties including microbial biomass, denitrifying bacteria abundance, and rates of denitrification and soil respiration.

METHODS AND MATERIALS

Soil Collection Sites—Soils used in this study are from three cotton (*Gossypium hirsutum* L.) and three soybean (*Glycine max* Merr.) fields in the Mississippi Delta. Fields from which soil samples were collected are in Leflore County (one cotton and one soybean field at Runnymede Farms, 1.6 km SE of the town of Itta Bena), Coahoma County (two cotton fields on the Omega Plantation, 5 km E of Clarksdale), and Quitman County (two soybean fields at Hauff Farms, 10 km E of Clarksdale). The soils in these areas are Southern Mississippi Valley alluvium of the Dubbs-Dundee-Forestdale association (USDA 1959a; 1959b). They have organic matter concentrations less than 1.0%, pH values between 4.4–5.7, and depending on the site consist of approximately 20–55% sand, 40–60% silt, and 5–40% clay (A&L Analytical Laboratories, Inc., Memphis, TN).

Experimental Design—All soils used in this study were collected in early January 1998. At each of the four agricultural fields sampled in Coahoma and Quitman Counties, two 19-liter plastic buckets were filled with soil collected along a 30-m transect. Depth of soil collection did not exceed approximately 30 cm. At each of the two field sites in

Leflore County, four buckets were filled using a similar method. Following collection, soils were transported to our laboratory at the University of Mississippi, Oxford, 120–150 km from the field sites. Soils from each site were homogenized by manual mixing with a spade and distributed into cylindrical 4.2-liter polyethylene microcosms (model # RSF4, Cambro Manufacturing Co.). Each microcosm contained a dry soil mass of approximately 2.4 kg, having a depth of 13 cm and a surface area of 17 cm². Twelve microcosms were prepared per field site (cotton or soybean) in Coahoma and Quitman Counties, and twenty-four microcosms for each field in Leflore County.

Six microcosms from each Coahoma and Quitman County field site, and twelve of the microcosms containing soil from each Leflore County field, were “flooded” with deionized water to a depth of 5 cm above the soil surface (approximately 1.1 liter). Throughout incubation, deionized water was added to these flooded microcosms as needed to maintain a depth over the soil surface of 5 cm. To the other microcosms from each field, 200 ml of deionized water were added every two weeks for the first four weeks of the experiment, equivalent to a rain event of approximately 0.9 cm in depth over the soil surface. For the remainder of the experiment, 100 ml of deionized water were added to these microcosms weekly. A record of soil moisture contents was maintained throughout the experiment. Non-flooded soils had a gravimetric water content of 16–20%. Soils in flooded microcosms ranged between 28–30% water, but were continually overlain with water.

To expose the microcosms to ambient outdoor light and temperature, they were incubated on the flat roof of Shoemaker Hall on the University of Mississippi campus. The microcosms were placed randomly into one of four insulated, open-topped wooden boxes (24 microcosms per box). A sheet of OP-4 plexiglass (AIN Plastics) was positioned 10 cm above the top of the microcosms. OP-4 plexiglass transmits all ultraviolet and visible light, and served to prevent precipitation from entering the individual microcosms, allowing us to precisely regulate soil moisture and water depth. Air temperatures at the incubation site were provided by the U.S.D.A.-A.R.S.

On each sample date one flooded and one non-flooded microcosm from each cotton and soybean field were sampled, except for the Leflore County fields from which two microcosms were sampled

from each field. From each microcosm, one soil sample of 150 grams (dw) was collected with a 2.5-cm plastic corer to a depth of 8 cm. Concurrently, water samples from the flooded microcosms were collected from the overlying surface water. Each microcosm was sampled only once, i.e. destructively.

The first samples were taken on January 4, 1998, prior to flooding. The microcosms were flooded on January 5. Four samples were taken during the period of flooding at approximately two-week intervals, until day 57 of flooding. After 20 more days, during which no samples were collected, the flooded microcosms were drained by slowly pouring off the surface water. Final samples from the microcosms were taken 18 days later on April 10, at which point gravimetric soil moisture content averaged 13% in both previously flooded and non-flooded microcosms.

Analytical Methods Used for Measurements of Soil and Water Chemistry—Prior to all chemical and biological analyses, soil samples were individually homogenized by manual mixing. Soils were analyzed for ammonium and nitrate using the accelerated diffusion method (Khan et al. 1997). Measurements of total nitrogen and total organic carbon in the soils were made with a Leco CN2000 soil analyzer. Total phosphorus in soils, measured on only the first (pre-flood) and last days of incubation, was analyzed by the ascorbic acid method on 0.45- μ m filtrates of samples prepared by sulfuric acid persulfate digestion (APHA 1995). All measurements of soil chemistry were normalized by mass (kg) of dried soil. Samples of overlying water were filtered through Whatman 42 paper or GF/F filters (total phosphorus only) and analyzed for dissolved nitrate, ammonium, and total phosphorus, using the same methods as described for soil extracts. For determination of moisture content, the soils were weighed, dried at 60°C to a constant weight, and re-weighed. Particulate organic matter content was estimated as the difference in soil weight before and after combustion at 500°C.

Procedures Used for Measurements of Denitrification and Soil Respiration—Denitrification and respiration rates of microcosm soils were made in conjunction with measurements of soil and water chemistry. On each measurement date, one microcosm from each of the four Coahoma fields, and two microcosms from each of the two Leflore County fields were sampled, once for each measurement of denitrification and respiration. Following these measurements, the microcosms were sampled for soil

and water chemistry (see above), and microbial community parameters (see below).

Denitrification was estimated by the acetylene-block method (Mosier and Klemmedtsson 1994). For these measurements, an open-ended chamber was inserted 10 cm into the soil. Chambers were 60-cm long by 7.5-cm inner diameter PVC pipe capped at the upper end. To enable gas sampling, a 4-mm rubber septum was fitted into a hole in the side of the chamber. While the chamber was being set a 20-ga needle was inserted into the septum to allow air inside the chamber to equilibrate with atmospheric pressure. Following placement of the chamber, 60 ml of sulfuric acid washed C_2H_2 (NexAir, Memphis, TN) was injected by syringe into the chamber headspace. To mix the gas through the chamber and into soil pores the syringe was used as a pump to alternately reduce and increase internal pressure (Mosier and Klemmedtsson 1994). Overpressure due to added C_2H_2 was vented by momentary replacement of the needle into the septum. Two to four hours later, a 5-ml sample was removed from the headspace of each chamber for an initial measurement of N_2O concentration. Two more samples were taken subsequently at 3-hour intervals.

N_2O concentrations were analyzed on a Hewlett-Packard 5890A gas chromatograph equipped with an electron capture detector, using 95% Ar 5% CH_4 carrier gas (NexAir, Memphis, TN) (Crill et al. 1995). N_2O was separated on a 2-m long, 3.2-mm outer diameter stainless steel packed column using 60–80 mesh sized Porapak-Q packing material. N_2O concentrations were calculated from linear regression equations obtained from injecting gas standards made by diluting pure N_2O (+99% N_2O , Aldrich) in ultra high purity nitrogen (~99.998% N_2 , NexAir). N_2O flux rate was determined as the slope of the linear regression between sample concentration and incubation time. Denitrification rates by soil surface area were determined as

$$\text{Denitrification rate (N}_2\text{O surface area}^{-1} \text{ time}^{-1}) = \text{volume N}_2\text{O evolved} \times \text{N}_2\text{O density} \times \text{incubation time}^{-1} \times \text{chamber surface area}^{-1}$$

where N_2O density equals 1.8 g l⁻¹ (at 25°C and standard pressure).

Soil respiration was determined prior to the denitrification measurements by capture in a base trap of CO_2 evolved during incubation in a closed space (Zibilske 1994). Four ml of 2M NaOH in 20-ml scintillation vials were placed into each micro-

cosm to be sampled. In the case of the flooded microcosms, the vial was set on a 10-cm glass petri dish floating on the water surface. The microcosms were sealed for 6 to 18 hours, then the vial removed for chemical analysis.

CO_2 dissolved in the NaOH was determined by titration with 0.1M H_2SO_4 after the addition of 3M $BaCl_2$, with phenolphthalein used as an endpoint indicator (Zibilske 1994). Sample values were corrected for blank measurements using microcosms not containing soil or water, but were not corrected for the possibility of supersaturation of CO_2 in the water-column of flooded microcosms. Respiration rates were calculated as

$$\text{Respiration rate (CO}_2\text{ surface area}^{-1} \text{ time}^{-1}) = (\text{CO}_2 \text{ chamber} - \text{CO}_2 \text{ blank}) \times \text{incubation time}^{-1} \times \text{chamber surface area}^{-1}$$

Procedures Used for Examination of Nutrient Limitation of Denitrification—To determine if N or C availability limited soil denitrification, an experiment was conducted using soils from the 16 microcosms remaining on the final day of incubation. These measurements were made 25 days after drainage. From each microcosm, 50 grams of soil were removed and placed into 4 0.5-liter Atlas7 brand wide-mouth Mason jars for a total of 64 jars. Of the 4 jars prepared from each mesocosm, one jar received only 50 ml of deionized water, 4 jars received a 50-ml solution containing 5 mg NO_3-N (as KNO_3), 4 jars received a 50-ml solution containing 10 mg $C_6H_{12}O_6-C$, and 4 jars received a 50-ml solution containing both NO_3-N and $C_6H_{12}O_6-C$ as above. Twenty-four hours later, H_2SO_4 -washed C_2H_2 at 10% of the jar volume was added. Subsequently, two measurements from the jar headspaces were made 5 to 6 hours apart to determine denitrification flux rates.

Procedures Used for Measurements of Microbial Abundance and Biomass—Soils were analyzed for total microbial biomass and denitrifying bacteria populations one day prior to flooding and on the last day of incubation. The fumigation extraction method and ninhydrin-nitrogen reaction methods were used to determine microbial biomass (Joergensen 1995a; 1995b). The most probable number method was used to estimate the abundance of denitrifying bacteria (Tiedje 1994).

Data Analysis—A summary description of the experiment is that it was conducted using a split-plot repeated-measures design, where the main plot was

field site nested in crop (3 fields of each of two crop types: $n = 6$ samples), the split-plot was the water treatment (flooded or not flooded: $n = 6 \text{ samples} \times 2 \text{ water treatments} = 12$), and the repeated-measures was incubation time (5 measurements per sample: $n = 6 \text{ samples} \times 2 \text{ water treatments} \times 5 \text{ times} = 60$ measurements per factor). Statistica 99 software (StatSoft Inc.) was used in all statistical analyses. To reduce the possibility of Type II error associated with potentially high variability in soil parameters, an alpha level of 0.1 was considered significant. For all soil chemistry parameters for which there were data collected during the flooded period, we conducted repeated-measures factorial ANOVA using the first five sample dates (i.e., prior to drainage). Additionally, for all measurements of soil chemistry, as well as soil microbial parameters, we conducted a repeated-measures analysis using only the pre-flooding and post-flooding data. Only one-half the microcosms (36) contained surface water, which did not allow sufficient error degrees of freedom for analysis of water chemistry by repeated-measures ANOVA. Instead, we analyzed water chemistry as a split-plot ANOVA, with flooding time treated as a continuous variable. As we had two measurements for each date from each Leflore County field, but only a single measurement from the other fields, the two measurements from each date for the Leflore County fields were averaged for statistical analysis.

Because of several missing values (lost during sampling), a repeated-measures analysis was not appropriate for analysis of effects of flooding or crop

type on denitrification and respiration rates. Instead, these data were analyzed as a split-plot ANOVA. Temperature and flooding time were placed in the model as continuous variables and, as above, the effect of field variability removed by nesting the field term in crop type. Denitrification and respiration data for the final sampling date were analyzed by two-way ANOVA for effects of previous crop type and flooding regime. The relationships of respiration and denitrification to temperature were analyzed by least-squares regression. In the experiment examining limitation of soil denitrification, we tested for main and interaction effects of carbon and nitrate additions, previous crop type, and water regime using factorial ANOVA.

RESULTS

Air temperatures above the microcosms during the experiment ranged between 4 and 28°C (Fig. 1). Occasional measurements of soil temperatures revealed little difference between flooded and non-flooded soils, and based on previous observations from winter 1997, microcosm soil temperatures were similar to field soil temperatures (Milburn 1999).

Crop type had no effect (either main or interaction) on concentrations of any of the variables we measured in soils or water ($P > 0.1$); therefore, figures showing temporal trends in soil and water chemistry do not indicate crop type. In the flooded soils $\text{NH}_4\text{-N}$ concentration increased, whereas in the non-flooded it declined slightly (Fig. 2a). Soil $\text{NH}_4\text{-N}$ was significantly higher (up to 5 times) in flooded soils during the period of flooding, although the magnitude of the effect varied with time. The second sampling date was not included in the ANOVA due to very low values attributed to analytical error. Post-flooding $\text{NH}_4\text{-N}$ concentration in the flooded and non-flooded soils were similar, at approximately 1.5–2.5 mg $\text{NH}_4\text{-N}$ per kg soil dw.

On all sample dates during flooding, there was a higher $\text{NO}_3\text{-N}$ concentration in non-flooded soils (up to 3 times); the magnitude of the effect varied with time (Fig. 2b). There was no difference in soil $\text{NO}_3\text{-N}$ concentrations following drainage.

Total N in soil varied little during flooding, or between pre-flooding and post-flooding (Fig. 2c). Total soil P, soil organic C, and percent organic matter also were not significantly different between flooded and non-flooded soils, or between pre-

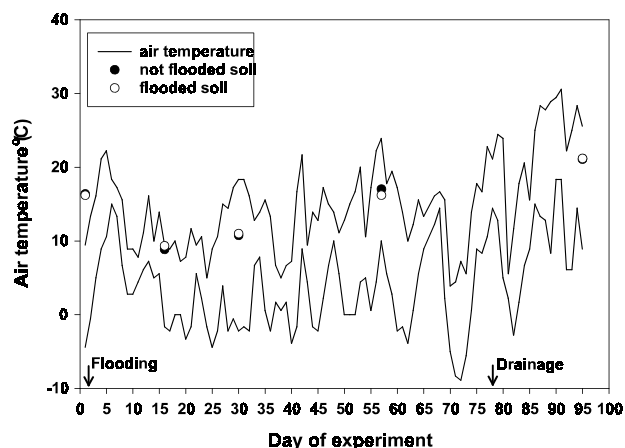


Figure 1. Maximum and minimum air temperatures in Oxford, MS during the experiment. Soil temperatures on five dates are also shown. Day 1 is the first day of flooding. Soils were drained after 77 days of flooding.

flooding and post-flooding (Figs. 2d–f).

Mean concentrations over time of $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, and total P in overlying water of flooded microcosms were generally less than approximately 0.5 mg N or P l^{-1} , and not significantly different between crop types (Figs. 3a–c), although there was substantial variation between fields as indicated by large standard errors. Only total P, which declined from a

mean (both crops) of 0.56 mg l^{-1} to a mean of 0.12 mg l^{-1} during flooding, showed a consistent pattern in time.

Denitrification in flooded microcosms during flooding ranged from a daily mean of 2.1 to 16.3 mg $\text{N}_2\text{O-N ha}^{-1} \text{ d}^{-1}$ in cotton soils, and 2.6 to 17.3 mg $\text{N}_2\text{O-N ha}^{-1} \text{ d}^{-1}$ for soybean soils (Figs. 4a, b). Denitrification rates in non-flooded microcosms during the same time period ranged from 1.5 to 12.6 mg $\text{N}_2\text{O-N ha}^{-1} \text{ d}^{-1}$ in cotton soils, and 2.0 to 21.5 mg $\text{N}_2\text{O-N ha}^{-1} \text{ d}^{-1}$ for soybean soils. During flooding, temperature was positively correlated to denitrification rate ($r^2 = 0.37$), and was the only factor examined that significantly ($P < 0.01$), although poorly, appeared to influence denitrification rate.

Respiration measurements during the first two days of flooding (days 13 and 20) are considered unreliable due to very high variance and several negative values, and will not be considered further. Respiration rates were always higher in non-flooded compared to flooded soils. During days 40 and 53, they ranged from 87 to 261 g $\text{CO}_2\text{-C ha}^{-1} \text{ d}^{-1}$ in flooded cotton soils, and 44 to 266 g $\text{CO}_2\text{-C ha}^{-1} \text{ d}^{-1}$ in flooded soybean soils (Figs. 4c, d). In the non-flooded microcosms, respiration rates ranged from 88 to 435 g $\text{CO}_2\text{-C ha}^{-1} \text{ d}^{-1}$ in cotton soils, and 232 to 495 g $\text{CO}_2\text{-C ha}^{-1} \text{ d}^{-1}$ in soybean soils during the same time period. The highest respiration rates in both cotton and soybean soils occurred at the warmest soil temperatures.

Denitrification after drainage was significantly influenced by prior flooding only in cotton field soils (Figs. 4a, b). Denitrification in previously flooded cotton field soils averaged 37 (SE = 13) mg $\text{N}_2\text{O-N}$

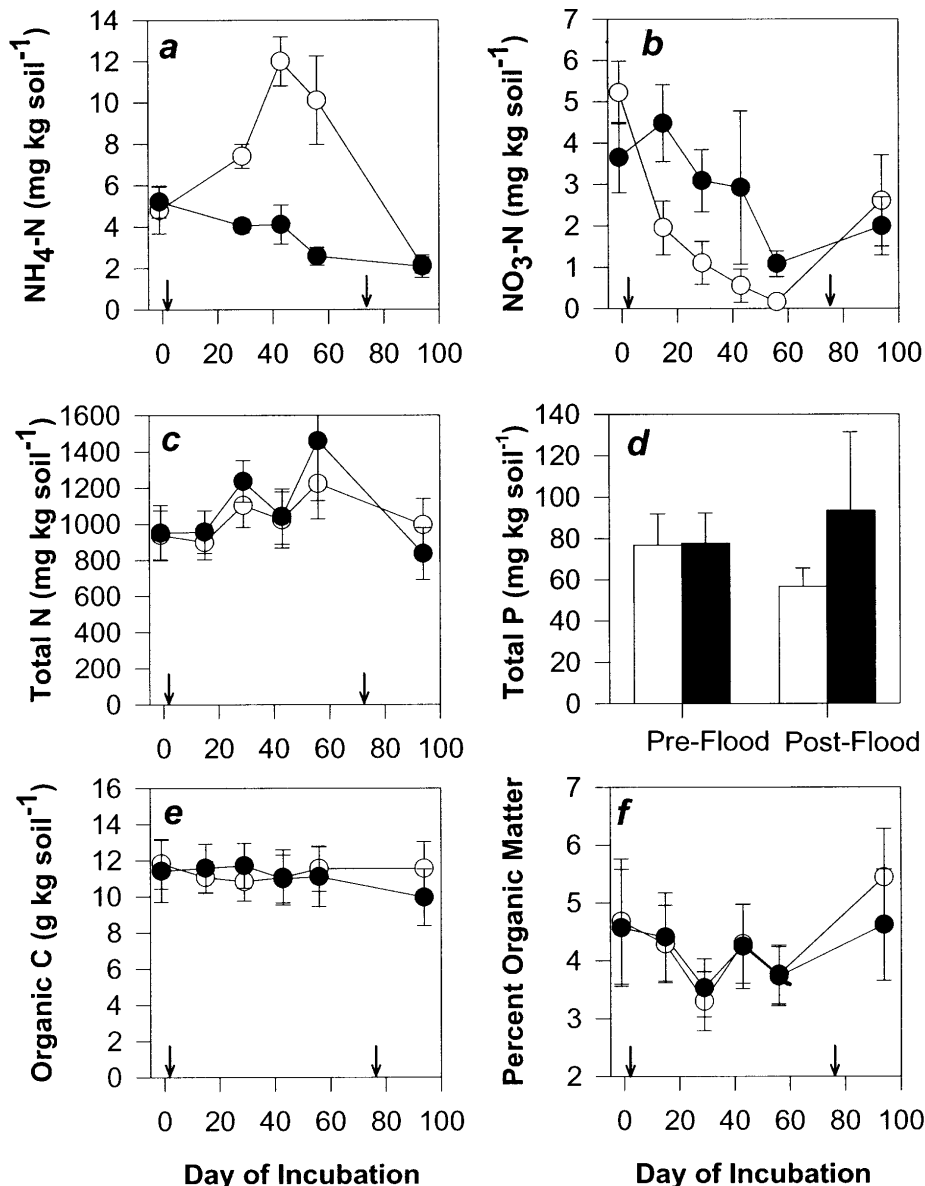


Figure 2. Soil chemical concentrations in flooded (○) and non-flooded (●) soils from cotton and soybean fields. Arrows indicate the first day of flooding (day 1) and the date of drainage (day 77). Error bars indicate the standard error ($n = 6$). (a) Ammonium-nitrogen; (b) Nitrate-nitrogen; (c) Total nitrogen; (d) Total phosphorus; (e) Organic carbon; (f) Percent organic matter.

ha⁻¹ d⁻¹, but was undetectable in previously non-flooded soils. Denitrification in post-flooding soybean soils was undetected in both previously flooded and non-flooded soils. Mean respiration rate in post-flooding cotton soils was 426 (SE = 49) g CO₂-C ha⁻¹ d⁻¹ if previously flooded, and 622 (SE = 174) g CO₂-C ha⁻¹ d⁻¹ in soils that had not been flooded (Fig. 4c). Mean respiration rate in post-flooding soybean soils was 538 (SE = 217) g CO₂-C ha⁻¹ d⁻¹ if previously flooded, and 797 (SE = 222) g CO₂-C ha⁻¹ d⁻¹ in soils that had not been flooded (Fig. 4d). The post-flooding respiration measurements exhibited high variance, with no significant effects of either soil type or flooding regime.

In the experiment to determine nutrient limitation of post-flooding denitrification, rates ranged from 0.03 to 8.6 mg N₂O-N kg⁻¹ d⁻¹ in cotton soils, and 0.05 to 8.7 mg N₂O-N kg⁻¹ d⁻¹ in soybean soils (Table 1). Both organic C and NO₃ addition alone significantly increased denitrification, but the highest rates of denitrification in both crop types was when both were provided.

Assuming a typical flooded period of 90 days, denitrification accounted for less than 0.0002% of total N stored in both flooded and non-flooded soybean and cotton soils (Table 2). Loss of soil organic C by microbial respiration was also small relative to soil organic C content, accounting for less than 0.3% of the organic C pool in all cases.

Results of a comparison of nutrient concentrations in overlying water from microcosms containing Leflore County cotton field soils to concentrations in run-off from the same field measured in 1997–98 by the Mississippi Department of Environmental Quality (Green 1998) are shown in Table 3. Only data from the Leflore County fields are included, because only these fields were monitored for soil erosion. The data are not perfectly comparable because they were determined using different methods and are unequal in number. However, they suggest that flooding could decrease losses of dissolved total P substantially, and NH₄-N, compared to losses by erosion.

Soil microbial biomass ranged between about 60 to 80 mg kg⁻¹ soil (Fig. 5a) and was unaffected by flooding or crop type. Most probable numbers of denitrifying bacteria were approximately 4.5 X 10⁶ cells per gram soil prior to flooding in cotton soils

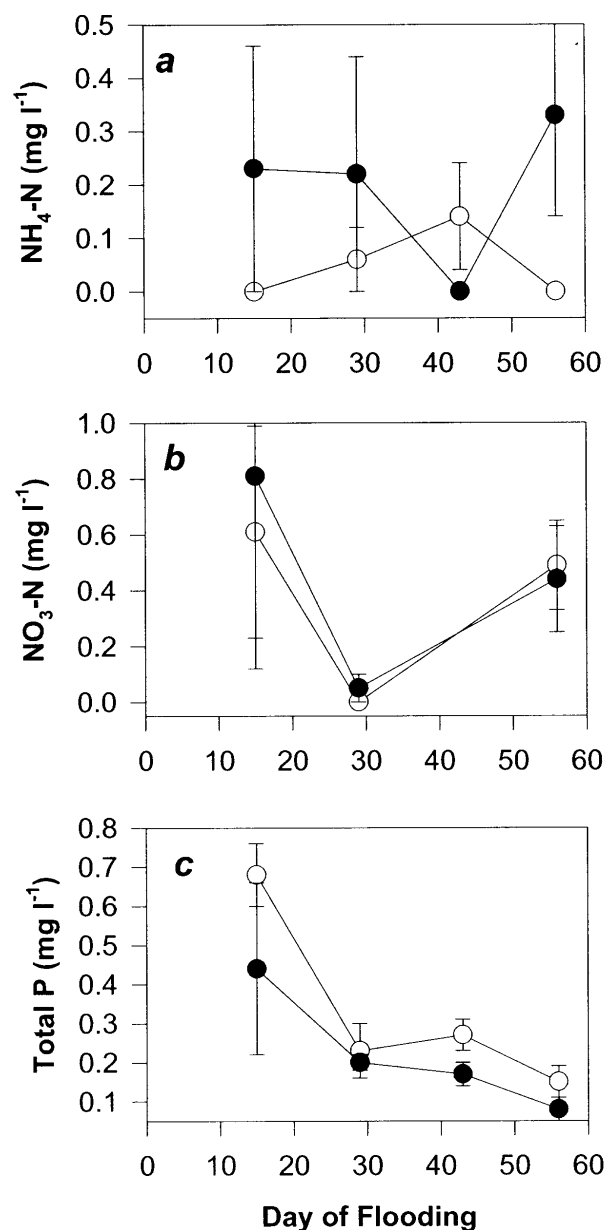


Figure 3. Chemical concentrations in overlying water of flooded cotton (○) and soybean (●) soils. Error bars indicate the standard error (n = 6)

(Fig. 5b), and 2–3 X 10⁶ cells per gram soil prior to flooding in soybean soils (Fig. 5c). There was no significant effect of flooding on abundances of denitrifying bacteria in either soil.

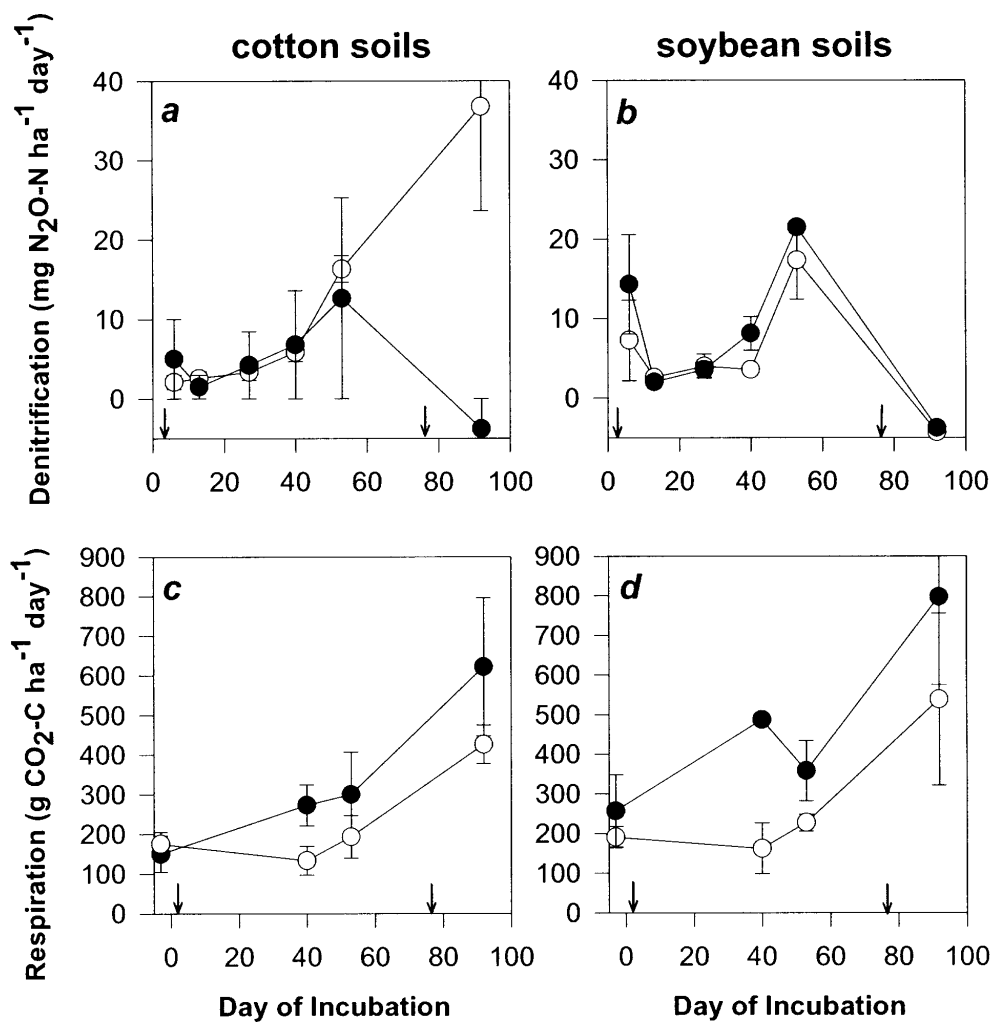


Figure 4. Rates of denitrification and respiration by time of flooded (○) and non-flooded (●) soils from cotton and soybean fields. Arrows indicate the first day of flooding (day 1) and the date of drainage (day 77). Error bars indicate the standard error (n = 3). (a) Denitrification in cotton soils; (b) Denitrification in soybean soils; (c) Respiration in cotton soils; (d) Respiration in soybean soils.

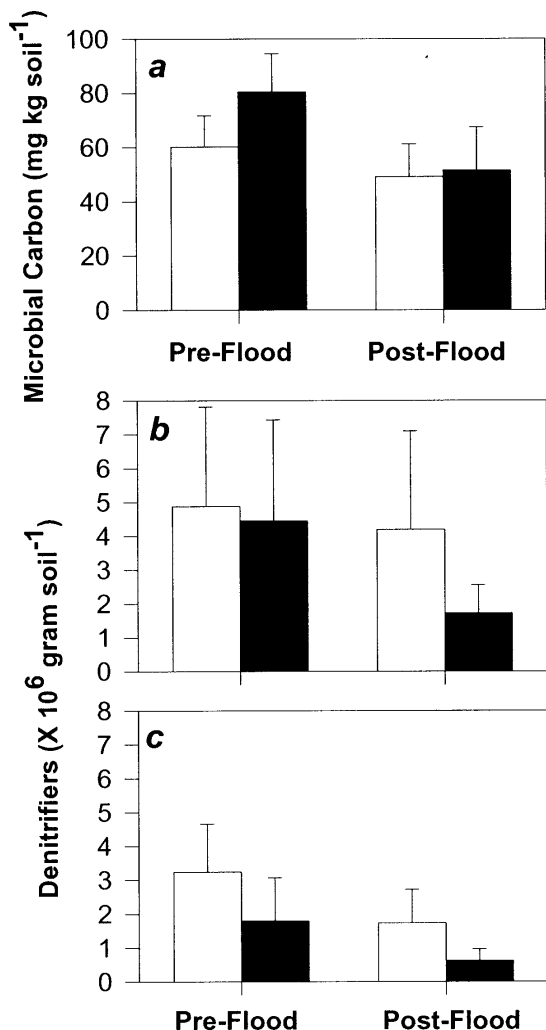


Figure 5. Microbial community parameters of flooded (□) and non-flooded (■) soils from cotton and soybean fields. Error bars indicate the standard error. (a) Microbial biomass (n = 6); (b) Most probable number of denitrifying bacteria in cotton field soils (n = 3); (c) Most probable number of denitrifying bacteria in soybean field soils (n = 3).

Table 1. Factors affecting denitrification rates in post-flooding soils. Samples were supplemented (+) or not supplemented (-) with N and P.

Treatment Factor				Denitrification Rate		
Crop	Flooded	N	C	mean	SE	CV
				(mg N ₂ O-N kg ⁻¹ d ⁻¹)		
Cotton	no	-	-	0.04	0.01	0.31
Cotton	no	+	-	0.04	0.05	1.11
Cotton	no	-	+	1.90	1.78	0.95
Cotton	no	+	+	8.50	2.03	0.24
Cotton	yes	-	-	0.03	0.00	0.04
Cotton	yes	+	-	0.05	0.05	1.12
Cotton	yes	-	+	1.80	1.60	0.90
Cotton	yes	+	+	8.60	1.48	0.17
Soybean	no	-	-	0.06	0.05	0.98
Soybean	no	+	-	0.11	0.11	0.94
Soybean	no	-	+	4.10	1.89	0.47
Soybean	no	+	+	8.70	3.97	0.45
Soybean	yes	-	-	0.05	0.05	0.98
Soybean	yes	+	-	0.59	0.92	1.55
Soybean	yes	-	+	3.70	1.74	0.47

Table 2. Percent losses of nitrogen and carbon by denitrification and respiration relative to initial concentrations of total nitrogen and organic carbon in cotton (CT) and soybean (SOY) soils. F = flooded; NF = not flooded.

Soil	TN ^{a,b} (kg ha ⁻¹)	C ^{a,b} (kg ha ⁻¹)	Denitrification ^c (kg ha ⁻¹ 90 d ⁻¹)	Respiration ^c (kg ha ⁻¹ 90 d ⁻¹)	%Denitrif ^d	%Resp ^d
CT-NF	1220	15300	0.001	17.4	0.0001	0.11
CT-F	1220	14800	0.002	27.0	0.0001	0.18
SOY-NF	1220	15400	0.002	20.4	0.0002	0.13
SOY-F	1250	14900	0.002	43.8	0.0001	0.29

^aPre-flooding means of total N and organic C concentrations in soils.

^bSoil weight (dry) is 1.3 X 10⁶ kg ha⁻¹ for a soil depth of 10 cm.

^cMaximum mean values for the flooded period (all are from day 57).

^dPercent values are relative to pre-flooding concentrations in soils.

Table 3. Concentrations of dissolved nutrients in overlying microcosm water after 57 days of flooding compared to average losses by erosion from Leflore County fields.

Field type	Chemical	Concentration in Water (mg l ⁻¹) ¹	Loss by Erosion (mg l ⁻¹) ²
Cotton	NH ₄ -N	0.00–0.17 (n = 4)	0.68 (n = 14)
	NO ₃ -N	0.00–0.31	0.13
	Total P	0.10–0.71	3.5
Soybean	NH ₄ -N	0.00	
	NO ₃ -N	0.00–2.44	
	Total P	0.13–0.64	

¹Values are the range for the four dates of flooding, and for dissolved materials only.

²Erosion data from MS DEQ, 1997–98, and are the averages over 14 dates in 1997–98 for total materials in runoff from the field (Green 1998).

DISCUSSION

The primary conclusion of this experiment is that continual simulated flooding of these six agricultural soils for between 57 and 77 days during winter had little or no detectable effect on post-flooding soil

nutrient concentrations or measured microbial community parameters. In contrast, during the period of flooding there were clear and sustained differences in soil concentrations of NO₃-N and NH₄-N between flooded and non-flooded soils.

In only one case did flooding significantly affect

any of the measured microbial community parameters. Although, denitrification and soil respiration rates were unaffected by flooding during the period of flooding, denitrification in previously flooded cotton soils was higher than in previously non-flooded soils. In contrast, denitrification in soybean soils was unaffected by prior flooding. Reddy and Patrick (1976) reported that denitrification is stimulated when soils are alternately flooded and dried compared to when soils are continuously wet or dry. This is in agreement with our observation of a pulse in N_2O release from cotton field soils following drainage, but does not explain why a similar pulse was not observed in the soybean soils.

Microbial biomass and denitrifying bacteria population size were unaffected by flooding; significant effects may have been difficult to detect due to inherently high variability in soil microbial data. For comparison, in a study conducted on a rice field in California, Bossio and Scow (1995) also did not detect changes in microbial biomass carbon, but did observe increases in soil respiration, due to wintertime flooding.

From the patterns in concentration changes in soil $\text{NH}_4\text{-N}$ and $\text{NH}_4\text{-N}$ during and after flooding, inferences can be made regarding effects of flooding on activities of microorganisms in the N cycle of these soils. During the period of flooding, mean soil $\text{NH}_4\text{-N}$ concentrations increased from approximately 5 to 12 mg kg soil⁻¹. A similar pattern of increase in soil $\text{NH}_4\text{-N}$ under flooding has been observed in field experiments (Milburn 1999). The source of this $\text{NH}_4\text{-N}$ is uncertain, but is presumably due to mineralization of organic matter with release of $\text{NH}_4\text{-N}$ (ammonification). Under conditions of flooding, oxygen diffusion into the soils is reduced, nitrification would accordingly be negligible, and $\text{NH}_4\text{-N}$ would accumulate. In nonflooded soils, in contrast, $\text{NH}_4\text{-N}$ did not accumulate. Explanations for the latter result are that in the non-flooded soils, (1) rates of $\text{NH}_4\text{-N}$ production by mineralization were lower, (2) microbial assimilation of $\text{NH}_4\text{-N}$ was higher, and/or (3) nitrification rates were higher than in flooded soils. The respiration measurements indicate that organic matter mineralization was not higher under flooding. Although we cannot exclude the possibility of a difference in rates of $\text{NH}_4\text{-N}$ assimilation between flooded and nonflooded microcosms, differences in $\text{NO}_3\text{-N}$ concentrations suggest enhanced nitrification in nonflooded soil.

During the same 57-day period of flooding, mean soil nitrate concentrations declined in both flooded

and nonflooded microcosms from about 3.6–5.2 to 0.2–1.0 mg $\text{NO}_3\text{-N}$ kg soil⁻¹. Denitrification cannot explain this pattern, since in both flooded and non-flooded soils N loss by denitrification, although measurable, was much lower than the rates of decline in $\text{NO}_3\text{-N}$. For example, in the flooded soil there was a net loss by all mechanisms of approximately 5 mg $\text{NO}_3\text{-N}$ kg soil⁻¹ over the first 57 days of flooding (Fig. 2b). At the maximum observed denitrification rate in flooded soils of approximately 16–17 mg $\text{N}_2\text{O-N}$ ha⁻¹ day⁻¹ (Fig. 4a, 4b), the loss of N by this process accounts for only 0.0007 mg N kg soil⁻¹ over 57 days (for a soil depth of 10 cm, average dry weight is 1.3×10^6 kg ha⁻¹). Clearly, other processes are involved in the loss of $\text{NO}_3\text{-N}$. Diffusion of soil $\text{NO}_3\text{-N}$ into the overlying water is a possibility, but can account for only about 0.3–0.4 mg $\text{NO}_3\text{-N}$ kg soil⁻¹. Assimilatory reduction of $\text{NO}_3\text{-N}$ is a third possibility to explain the decline in soil $\text{NO}_3\text{-N}$, but as microbial biomass did not increase measurably during incubation (Fig. 5a) that explanation also is not fully satisfactory, and we consider the question unresolved at present.

Overall, oxygen concentration appears to have been the driving force in the regulation of soil microcosm $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ concentrations. The observed patterns are characteristic of wetland sediments, and indicate that typical wetland biogeochemical processes developed quickly in these flooded agricultural soils (Reddy and Patrick 1976; Mitsch and Gosselink 1993). This is despite the generally cold temperatures at which this experiment was conducted, where the microbial influence on chemical transformations would be expected to be less than at other times of the year. Low concentrations of labile organic matter in these highly eroded agricultural soils probably also contributed to limitation of microbial activity, as indicated by the test for nutrient limitation of denitrification (Table 1).

Besides denitrification, nitrogen may be lost from flooded soils by leaching into overlying water. If leaching was significant, it is possible that large quantities of nitrogen as well as phosphorus could be loaded downstream when the fields are drained, a result that would partly negate other benefits of wintertime flooding. However, our results indicate that flooding will substantially reduce losses of total phosphorus and contribute to a reduction in dissolved nitrogen in runoff from Mississippi Delta agricultural fields (Table 3).

The question remains: Is wintertime flooding a useful approach for controlling erosion of agricul-

tural soils in the Mississippi Delta, while preventing detrimental changes to either agricultural soil properties or downstream ecosystems? Green (1998) showed that soil and nutrient losses from agricultural fields in this region can be greatly minimized by managed wintertime flooding followed by controlled drainage. Although this experiment suggests minimal changes to soil chemical or gross microbial properties as a consequence of flooding, there are several possible experimental artifacts that must be considered before application of our results to a field situation. First, we used deionized water, instead of rainwater, to flood the microcosms. Where rainwater is a significant source of labile organic carbon and/or inorganic nitrogen, it is likely that microbial activity would be higher than measured here. In a field experiment, however, in which flooding was manipulated using surface runoff (the Leflore County cotton field of this study), we observed similar patterns in $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ as in this study (Milburn 1999). Second, we added water manually to maintain the non-flooded microcosms at constant water content. Using this method, we may have underestimated disturbance caused by raindrops falling on bare soil, the impact of which can dislodge soil particles and increase erosion. In this respect, flooding of the soils may have benefits in soil fertility that were not evident in this experiment, but that would be evident in the field (Milburn 1999). Third, during incubation, water was prevented from flowing out the bottom of the microcosms, eliminating possible nutrient losses by sub-surface flow. Where there is substantial percolation of surface water to deeper soil depths or groundwater, nutrient flux via sub-surface flow may be significant (Spaulding and Exner 1993). Clearly, however, many Mississippi Delta agricultural fields with limited surface run-off remain flooded for extended periods of time; this observation, in fact, was the basis of the approach to control erosion by blocking surface run-off that was the original impetus for conducting these experiments. Fourth, as it is risky to use results from short-term studies to predict long-term trends (Franklin 1989), we recommend that multi-year studies be conducted to examine the long-term effects on agricultural soils of intentional wintertime flooding. Finally, before wintertime flooding soils is widely applied, it is important to examine the potential effect of flooding on other chemical processes and soil biological communities. It is possible, for example, that production of methyl-mercury could be stimulated under flooded conditions. This highly

toxic compound is formed under anoxic conditions and where mercury deposition is a factor, formation of methyl-mercury under flooding should be evaluated (Atlas and Bartha 1998). Similarly, additional research should consider in detail the short- and long-term effects of flooding on the composition and activities of microbial and animal fauna, which represent soil biological diversity, and can be critical to the texture, chemical properties and fertility of soils.

ACKNOWLEDGMENTS

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The Occurrence of *Fusarium merismoides* var. *chlamydosporale* (Tuberculariaceae) in Rankin County, Mississippi

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This report documents the first occurrence of the fungus *Fusarium merismoides* var. *chlamydosporale* (Tuberculariaceae; Ascomycota) in Mississippi. The presence of this fungus was first observed in a rural area of Rankin County, Mississippi (Section 9, Township 3N, Range 5E) in March 2000, as a very wet, brilliant orange mass growing on a wild grape vine (*Vitis* sp.; Vitaceae). The fungus re-appeared on the same vine in March 2001, and March 2002, lasting for approximately 3 weeks at each occurrence. It was also found growing on a second host, ironwood (*Ostrya virginiana*; Betulaceae), in March 2001, and March 2002.

Samples were collected from both hosts during 2001 and 2002 and isolated to single colony (based on morphology and color) on minimal media plates (1% glucose, potassium chloride, nitrate salts, trace elements, 1.8% agar; Kafer, 1977). Bright orange material from the field isolates and from the laboratory subcultures were placed into 10 mM potassium phosphate, pH 7.4, and observed by Differential Interference Contrast microscopy using a Leica DM-LB microscope. Colony color and morphological structures identified from lab and field isolates from both years were identical. Micrographs and cultures were sent to Dr. Kerry O'Donnell, USDA, Agricultural Research Service, for assistance in identification of structures. Figure 1A shows a mature conidium and figure 1B shows a chlamydospore. The presence of canoe-shaped conidia and chlamydospores are characteristic for members of the genus *Fusarium* (Nirenberg and O'Donnell, 1998).

The genus *Fusarium* is large and morphologically diverse (Nirenberg and O'Donnell, 1998), and members of the genus are difficult to classify by morphological characteristics alone. The most reliable taxonomic placements of isolates are obtained by amplification and sequencing of the nuclear small subunit rDNA and mitochondrial rRNA as described in White et al. (1990). Samples were sent to the

laboratories of Dr. Meredith Blackwell (Louisiana State University) and Dr. Charles Mims (University of Georgia) for sequencing, and the sequences were subsequently sent to Dr. David Geiser (Pennsylvania State University) for comparison against a *Fusarium* database. An extensive database of *Fusarium* sequences is maintained by Dr. Geiser.

The sequences obtained were found to be 100% identical to those of *Fusarium merismoides* var. *chlamydosporale*, as described by O'Donnell (1992). This strain was first isolated from an ironwood tree (*Ostrya virginiana*) in Madison, Wisconsin, described by Wollenweber (1916–1935); the second was from rotting rhizome of *Asparagus officinalis* collected in Germany in 1968 and described by Gerlach and Nirenberg (1982). Thus, identification of this new isolate by morphologic and genetic means as *Fusarium merismoides* var. *chlamydosporale* represents only the third documented isolation of this

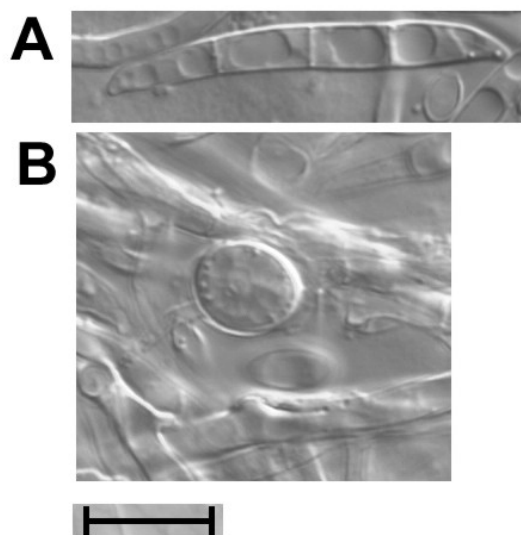


Figure 1. Morphological structures that place the isolate in the genus *Fusarium*. (A) mature canoe-shaped conidium; (B) chlamydospore. Bar = 10 μ m.

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strain world-wide, and the first in the southern United States.

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MSU Agricultural & Forestry Expt. Station
Mississippi University for Women
Pearl River Community College
University of Mississippi
University of Mississippi Medical Center
University of Southern Mississippi

First Report of Crazy Top in Mississippi River Delta Corn (*Zea mays*)

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The causal fungus of downy mildew, *Sclerophthora macrospora*, also causes crazy top in corn (*Zea mays*). It is a distinctive disease of corn and can cause economic losses in localized areas (Smith and Renfro, 1999). Crazy top was reported previously in Mississippi at State College, Mississippi (Broyles and Grogan, 1962), and has been reported in Tennessee, North Carolina, Iowa, Illinois, Indiana, Kentucky, New York, Pennsylvania, Missouri, Texas, and South Dakota (Hanlin et al., 1978; Ullstrup, 1970) as well as in various areas outside the U.S. (Ullstrup, 1970). A number of corn plants in the Mississippi river delta (Arkansas, Louisiana, Mississippi) were abnormally tall and vigorous late in the season and still light green where normal plants were maturing, indicating crazy top infection. The Mississippi delta is an important agricultural area of approximately 9 million acres, covering mainly Mississippi but also extending into Arkansas, Louisiana, Tennessee and Missouri. To quantify the disease incidence in 2000, five corn fields were selected from these counties in each of three states, Mississippi, Arkansas, and Louisiana. The relative number of plants infected with crazy top in each state ranged from 5–40% (MS), 2–8% (AR), and 2–5% (LA). In 2001, less than 2% of field corn plants surveyed were affected. In 2001, crazy top was also observed in 1–3% of the sweet corn grown in Arkansas. In 2002, Cliff Coker, Extension Plant Pathologist, observed crazy top at < 0.1% in several fields of field and sweet corn in the Arkansas-Mississippi River delta (personal comm.). Diseased plants showed varying symptoms. Infected plants were sometimes taller, and tassels proliferated into a mass of leaf-like structures (Fig. 1A). Infected ears became a mass of leafy structures instead of a normal kernel filled cob surrounded by a husk (Fig. 1B to D). Where kernels normally would have

developed, chlorotic leafy striping grew. Some infected plants did not have any ear involvement. The fungal structures of *S. macrospora* were detected in infected plant tissues by staining with zinc chloriodide (Aldrich, Milwaukee, WI, USA 53233-2681). The mycelium stained a deep purplish-blue, while the host tissue remained nearly colorless. Attempts to isolate the fungus using PDA were unsuccessful. In conclusion, crazy top was identified on field and sweet corn in the Mississippi, Arkansas and Louisiana Deltas. The disease incidence was greater 2000 probably due to heavy rainfall immediately after planting [DREC. 2002. Weather Station data (online) <http://ext.msstate.edu/anr/drec/stations.cgi>. Verified 10 June, 2002]. This disease is seldom of economic importance but can be avoided if fields are properly drained. The widespread occurrence of the disease in one growing season suggests that the pathogen may be common and the disease may reoccur with appropriate environmental conditions.

ACKNOWLEDGMENTS

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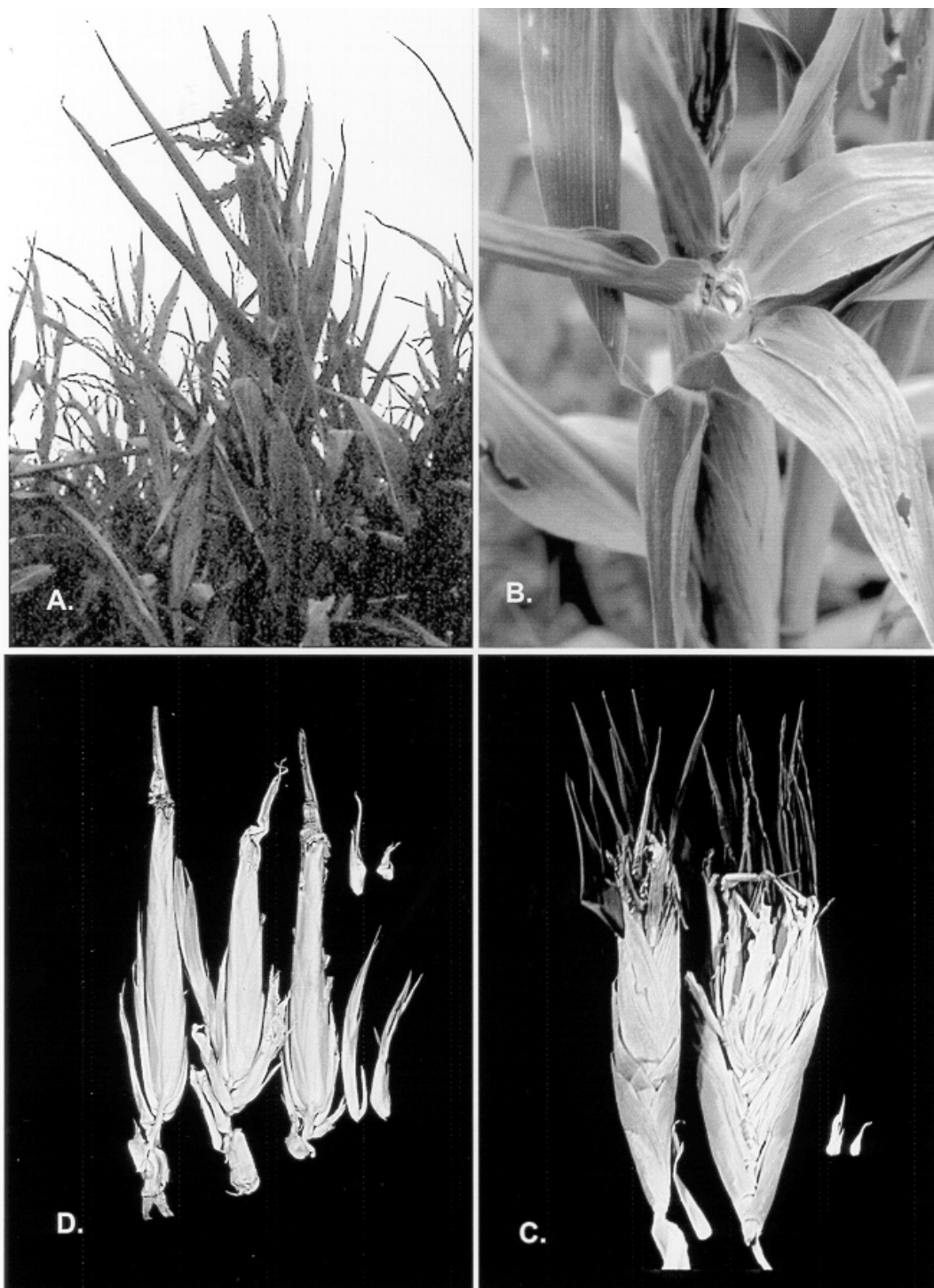


Figure 1. Symptoms and signs of crazy top on corn (A–D). A. Corn field in the Mississippi Delta in 2000 showing many infected corn plants exhibiting typical symptoms described as taller plants and tassels proliferated into a mass of leafy structures. **B.** Corn ear infected with crazy top, note husk and silk proliferated into a mass of leaf-like structures. **C.** Long section of infected corn ear with crazy top. Note where kernels normally developed, chlorotic leafy striping grew. **D.** Close-up of chlorotic leafy striping each arising from a single kernel. Note that kernels did not develop, but were replaced by leafy structures, both small and large.

President's Column

Thanks to the many people who participated in the 2003 MAS annual meeting in Hattiesburg this past February. We had a great time, with many good presentations, lots of exhibitors, old friends from across the state, and a dynamic Dogden lecturer. I was happy to hear many people commenting favorably about the fine facilities of the Lake Terrace Convention Center. We had good press coverage as well, with WDAM television and PRM both covering the event. I strongly encourage those of you who presented at the meeting to consider publishing your work in the Journal of the MAS.

It is up to the membership to see that the Academy grows and plays an important role in promoting science in our state. To this end I am asking members to do two things. First, encourage your scientific colleagues to become active in MAS. For a variety of reasons, some people who were active in the past

have become inactive and need encouragement to rejoin. Those who have never been active in the Academy may join if you explain the good we do in networking of scientists across the state and in promoting science education.

The second thing I ask of the membership is to help us plan for the future. As MAS President, I am gathering the MAS Board of Directors for a planning retreat in late spring. We would appreciate your input into this planning process. You may send your suggestions to me directly at robert.bateman@usm.edu or we will soon have an online form on the Academy webpage at www.msacad.org to input your comments and suggestions. This is your chance to play a role in the future direction of the Mississippi Academy of Sciences. Please give it some thought and discuss it with your colleagues. Thank you for all you do for the Academy!—Bob Bateman

Ex-Executive Officer's Column

It's true. After thirteen years as Executive Officer of the Mississippi Academy of Sciences, I have stepped down to allow new blood to flow into this office. Dr. Charles Swann of the Mississippi Mineral Resources Institute at Ole Miss has been ratified by the membership at our Annual Meeting as the new Executive Officer. Charles is an outstanding individual and will provide superb service to the Academy.

I would be remiss if I did not thank the people who helped me in my attempts to provide guidance to the Academy. All of the Presidents I worked with were excellent choices. Each had a different style of operation, but that made life interesting. I was fortunate to be able to follow in the footsteps of former Executive Officer Dudley Peeler. Dudley left the MAS in great shape and made the start of my tenure especially easy. But I was most fortunate to have the incredibly able assistance (and frequent guidance) of three fantastic Associate Executive Officers. They really ran the office; I just tried to fix the computers. Arlene Adams got me started; Gretchen Gulmon kept me on the path, and Cynthia Huff has tried her best to keep the path clear of land mines. Charles will soon find out how fortunate he is that Cynthia is in charge! In my opinion, the heart of the Academy has been its Journal editor. Ken Curry has been a rock in this position and has always strived for excellence. He also showed me the path.

I'm not vanishing, so I'll still be doing MAS

things. And Charles has my phone number and email address if he has trouble filling out the income tax forms. On second thought, perhaps it would be best if I changed those numbers!

I can't go away without pointing out what a great Annual Meeting we just had! I must confess that I was really hesitant when, as President-Elect, Bob Bateman said we should try to have our meeting at the Hattiesburg Convention Center. We had already investigated and knew that it was a lovely facility, but it was expensive! Bob is a determined kind of guy and he charged ahead; found funding for the meeting; and convinced us all that we should do this. Boy, was he right! The exhibitors were located in the main hallway and the posters were collected together as in a real poster session. The breakout rooms were excellent. It had a really good feel about it!

Dr. Marie Danforth must have some connections. She served as Publicity Chair and may be in that position for life. For the first time in memory, we had coverage of our meeting by Public Radio in Mississippi. There were two presentations about the MAS and our meeting. I was fortunate enough to hear both live (just luck since they did not tell us about them!). But you can check them out at the PRM archive at: <http://www.etv.state.ms.us/news/0302/stories.html#030219>. The first story was aired on February 14 and was titled "67th Annual Statewide Science Conference in Hattiesburg." The lead-in was: "Sci-

entists are in Hattiesburg for their annual statewide science conference. PRM's Scott Phillips will have a report.” The second story was a major piece, over four minutes long, and was presented on February 19. Its title was “Scientists Converge On Hattiesburg for 67th Annual Science Conference” and the lead-in was very complementary to us: “Last week some of

Mississippi’s brightest minds gathered in Hattiesburg for the 67th annual Mississippi Science Conference. PRM's Scott Phillips was on hand for the event and files this report.”

As that story says, it’s been my honor serving “some of Mississippi’s brightest minds”! See you the next meeting.—John Boyle

Divisional Reports

Agriculture and Plant Science

The division of Agriculture and Plant Science had eleven oral and eight poster papers. Graduate and undergraduate paper competition was the central part of the presentations to promote student participation. Nine papers were presented by the students. The contest consisted separate poster and oral sessions, which was evaluated by a panel of judges. Cash and certificates were awarded to the first, second and third place winners. Ms Maritza Abril of University of Southern Mississippi won first place in graduate poster competition. Ms. Courtney Young and Ms Umeka Griffin of Jackson State University won first and second places respectively in the undergraduate poster competition. Mr. Edward Foan and Mr. Hernan Cobo of Mississippi State University won first place in the graduate oral competition. They tied for first place. Mr. Jeremy Russell of Mississippi State University, Mr. Greg Anazia of University of Mississippi, and Ms Shanise Brown of

Mississippi Valley State University won first, second and third places respectively in the undergraduate oral competition.

Dr. George T. Bates, professor of animal science and associate research director, Dr. Om P. Vadhwa, professor of agronomy, Dr. Patrick Igboke, professor of horticulture (all from Alcorn State University), and Dr. Linda Andrews, research professor of food technology, Mississippi State University, served as judges.

Piggly Wiggly, RiverHills Bank, State Bank and Trust Company (all in Port Gibson), and Mississippi Nursery and Landscape Association of Mississippi State University were the sponsors of cash awards and they donated \$575 for the winners.

Divisional business meeting was held following the award presentation. Dr. Juan Silva, professor of food technology, Mississippi State University, was elected Chairman and Dr. Om Vadhwa, Professor of Agronomy, Alcorn State University, was elected Vice Chairman.—Girish K. Panicker



From left to right: Dr. George T. Bates (judge), Mr. Hernan Cobo (graduate oral 1st place), Mr. Edward Foan (graduate oral 1st place), Dr. Girish K. Panicker (Chairman), Dr. Om P. Vadhwa (judge), Ms. Shanise Brown (undergraduate oral 3rd place), Dr. Linda S. Andrews (judge)

Cellular, Molecular and Developmental Biology

The Cellular, Molecular, and Developmental Biology Division (CMDB) held its annual meeting from 13-14 February, 2003, during the MAS Sixty-Seventh Annual Meeting in Hattiesburg. There were a total of 25 oral presentations spread out over the two days, grouped into five separate sessions ("Investigating Molecular Functions and Effects," "Molecular Aspects of Toxicology," "Searching For Genes and Proteins," "Ribozymes," and "Developing Molecular Tools.") We heard from three faculty members, eleven graduate students, ten undergraduate students, and one exceptional high school student. Audience members were enthralled and clamoured for more, but alas all good things come to an end and we must wait until next year to hear more gripping tales of research, discovery, tears, frustration, and triumph.

Thursday afternoon, a poster session unveiled an additional eleven arresting visual accounts of scientific progress. Due to the communal nature of this year's poster sessions, the CMDB Division did not get the opportunity to continue its ongoing research into the effect of awarding of random door prizes on poster session attendance. Hopefully, the experiment can be resumed next year. Nevertheless, poster presenters ably acquitted themselves in presenting and explaining their work.

Friday morning's slot was given over to a joint session with the Mississippi Functional Genomics Network (MFGN), ably chaired by George Santangelo of the University of Southern Mississippi. In this session, representatives of the MFGN described the infrastructure and opportunities available for state-wide collaborative research into post-genomic biomedically-related problems. This was probably the best-attended of the meeting's sessions and it generated a lot of interest and enthusiasm in the MFGN programs, facilities, and funding opportunities.

On Friday afternoon, the regular CMDB program resumed, and concluded with the division's annual business meeting and award ceremony. As has been the case in years past, the judges had a difficult time narrowing the field to a single graduate student winner and a single undergraduate winner. Presentations were again uniformly excellent, especially so from the undergraduate presenters who, though inexperienced, nonetheless held their audience as expertly as the seasoned pros. After much gnashing of teeth and rending of hair, the judges did announce

a single winner in each category. The Outstanding Graduate Student Presentation award was won by Ms Julie Vining Smith (University of Southern Mississippi; mentor Dr. Yuan Luo); this award was accompanied by a \$50 prize graciously provided by Fisher Scientific (courtesy of Ms Susie Emfinger.) The Outstanding Undergraduate Student Presentation award was won by Mr. David Norris (Millsaps College; mentor Dr. Sarah McGuire); this award was accompanied by a \$50 prize graciously provided by Scimetrics, Inc. (courtesy of Mr. Jeffrey Case.)

Dr. Yuan Luo (University of Southern Mississippi) was elected CMDB Division chair for the forthcoming year. Dr. Mary Haasch (University of Mississippi) was elected CMDB Division vice-chair for the forthcoming year.—Ross Whitwam.

Chemistry and Chemical Engineering

There were 22 oral and 16 poster presentations at the 2003 meeting for a total of 38 presentations. The presentations were consistently good, with many graduate and undergraduate students participating. The sessions went smoothly and we stayed very close to the posted schedule. Many of the presenters used Power Point for their talks, which caused a few problems as we worked to synchronize laptops and projectors. We may want to think through providing a laptop and projector but specifying the version of Power Point and the fonts to be used. Then presenters could bring a floppy disk/CD and use one machine that could be set up all the time. The audience varied in size from six to fifteen at any one time. I understand busy schedules, but it would be good if we could get more people to come and attend all sessions.

The poster session went well and had, at least for the first hour, a reasonable crowd. The posters varied widely in quality, though the competition for the top spots was tough. The students all seemed very well prepared to discuss their work, and the projects ranged over a wide range of topics.

Our 38 presentations this year is down from 42 in 2002 and significantly less than our average over the last six years. This is unfortunate, as the papers given demonstrated the breadth and quality of work being done in this state. I wish that more faculty would take advantage of this opportunity for their students to practice their oral presentation skills or to gain experience at creating a technical poster.

The divisional business meeting was held after the Poster competition on Friday. John Pojman of

The University of Southern Mississippi was vice-Chair of the division for 2003–2004 and he will be Chair for 2003–2004. The current Vice Chair, Timothy Ward of the Department of Chemistry at Millsaps College, will assume the Chair's duties for 2003–2004, including chairing the 2003 meeting to be held on the coast.

The following awards were given with the indicated prize:

Outstanding Presentation by a Graduate Student:
Chun Hwa See, The University of Mississippi (certificate and graphing calculator)

Excellent Presentation by a Graduate Student:
Giselle Schnaubelt, University of Southern Mississippi (certificate)

Outstanding Presentation by an Undergraduate Student:
Kristin Fairley, Tougaloo (certificate and graphing calculator)

Excellent Presentation by a Undergraduate Student:
Anisha Bajaj, Millsaps (certificate)

Outstanding Poster Presentation (tie for 1st)
Demarcio Reed, Jackson State (certificate and graphing calculator) and
Mary Moore, University of Southern Mississippi (certificate and graphing calculator)
—John O'Haver

Health Sciences

The Health Sciences (HS) Division at Annual MAS meeting was a success. There were close to 50 outstanding peer-reviewed projects that were presented at the HS division. Attendance was considered the largest HS division gathering in the last eight years. The scientific sessions were chaired by: Dr. Shelly Tucci, Dr. Ibrahim Farah, Dr. Olga McDaniel, Ms Zelma Cason, and Dr. Ham Benghuzzi. The highlight of the HS division was the students participation at all levels from numerous institutions. Student projects were judged by student award committee chaired by Dr. Shelly Tucci, Department of Orthopedic Surgery and Rehab at UMC. The projects were scored by 12 judges from seven different institutions and this year winners were:

Diploma of Excellence Award Shontell Credit, UMC & JSU



Shontell Credit (right), Olga McDaniel (left), Michelle Tucci (center)

Outstanding Graduate Award 1st Vernetta Coleman, UMC and JSU 2nd Pam Jones, UMC 3rd Felix Adah, UMC



Vernetta Coleman (right), Olga McDaniel (left), Michelle Tucci (center)

Outstanding Undergraduate Award 1st Urseline Hawkins, UMC and Tougaloo 2nd Nour Farah, JSU 3rd Kim Parker, Millsaps



Nour Farah (right); Olga McDaniel (left)

Outstanding Allied Health Award

- 1st Charla Corder
- 2nd Jeff Hansen
- 3rd Kim Pate



Charla Corder (right), Olga McDaniel (left), Michelle Tucci (center)

Outstanding High School Award

- 1st Suma De
- 2nd Ayesha Alam



Ayesha Alam (right); Olga McDaniel (left)

Outstanding Technician Awards

- 1st Lashundra Powell
- 2nd Ruth Anne Buckhalter
- 3rd Charity Peacock



Ruth Anne Buckhalter (right); Olga McDaniel (left)

—Hamed Benghuzzi

History and Philosophy of Science

The Division of History and Philosophy of Science met on February 14, 2003 during the 67th annual meeting of The Mississippi Academy of Science (MAS) held at the Lake Terrace Convention Center in Hattiesburg, Mississippi. There were nine presentations addressing interesting aspects of the philosophical and historical facets of science. Three of these presentations focused on the philosophical approach of species. As the Division Chair, I encouraged all the participants to consider publishing in the MAS journal, especially the graduate students since they will benefit from the invaluable experience of publishing in a peer-reviewed journal. At the divisional business meeting, the current vice-chair, Professor Kant Vajpayee from the University of Southern Mississippi stepped up as chair and Professor Robert Hamilton from Mississippi College, was elected vice-chair for next year.—Maritza Abril

Marine and Atmospheric Sciences

The Division of Marine and Atmospheric Sciences met for a one-day session on Thursday February 13, 2003 as part of the 67th annual meeting of the Mississippi Academy of Sciences. There were twelve oral and four poster presentations; regardless of format, most of the presentations included student co-authors and student presenters. Although total participation by long-term full members was reduced somewhat from previous years because of conflicts with at least two national meetings, the sessions were well-attended overall. As is typical at most meetings, there was somewhat sparse attendance (~10 persons) for the first couple of presentations in the morning, but business picked up as time went on. There was literally standing room only during the afternoon session.

Noticeably, but pleasantly, absent this year was the unfortunate practice of a group storming in to hear one of their colleagues present and then leaving as a group as soon as the talk was over. I would like to thank the attendees for their politeness and professionalism in this regard.

All but one of the oral presentations was in PowerPoint. I am happy to report that there were no major problems with the segue between successive talks. The week before the meeting, I sent an email message to every presenter and many co-authors

telling them that a laptop, with a CD-ROM drive and an external zip-drive, and a computer projector would be available at the meeting. I asked that each presenter come early, before his/her session was scheduled to start, so that we could upload the presentation to the computer desktop. Most presenters complied with this request and we were able to preview their presentations and correct any problems associated with the different versions of PowerPoint used. This strategy successfully eliminated the time delays between talks which we experienced during some of the previous annual meetings. I strongly recommend that this practice become standard for our Division, if not for every Division of MAS.

Although the Division has not recently given awards for the best student presentation, I would like to suggest that we explore the possibility of doing so at future MAS meetings. When one of the student presenters asked me “when will the judges be stopping by?” during the poster session, I had to sad duty to inform him that our division was not going to present awards. The quality of our student presentations, both oral and poster, was excellent and the students deserve some sort of recognition. Whether we can establish a small endowment for a monetary award or a plaque or whether we could regularly present a simple paper certificate for best student presentation is something that we full members should discuss. Of course, this also brings up the issue of judges and scoring, etc.

The Divisional Business Meeting was held immediately following the morning oral session. The current Vice-chair, Dr. Chet F. Rakocinski (The University of Southern Mississippi, Gulf Coast Research Laboratory), will assume the duties of Chair for 2003–2004. Dr. Charlotte A. Brunner (The University of Southern Mississippi, Department of Marine Science) was elected Vice-chair for 2003–2004 and will assume the duties of Chair for 2004–2005.—Patricia M. Biesiot

Mathematics, Computer Science and Statistics

The 2003 annual meeting of the Mississippi Academy of Sciences included the largest participation in the Division of Mathematics, Computer Science and Statistics in anyone’s memory. The presentations included twenty-two speakers and two posters in sessions that lasted two days. Certificates were presented to the winners of:

First Place, Student Presentation—Jianxiang Qiao

and Yang Ye

Second Place, Student Presentation—Mikhail Korablin and Oleg Bestseny

First Place, Student Presentation, Subsection on High Performance Computing—Hong Zhou

Second Place, Student Presentation, Subsection on High Performance Computing—Arunkumar Rajendran

Best Poster—Oleg Efimochkin

At the Division meeting, Vice Chair Ravinder Kumar was confirmed as incoming Chairperson and Andrew Harrell was elected as incoming Vice Chair. Members of the Division expressed the desire to continue close ties with the Mississippi Center for Supercomputing Research (MCSR) User Advisory Group who also held their annual meeting in conjunction with the Division.—Walter Brehm

Psychology and Social Science

The Division of Psychology and Social Science had a very successful meeting for 2003. In our second year as a combined division, we had a full day of excellent papers from undergraduate students, graduate students, and faculty.

Our day began with a special symposium, *Recent Research in Forensic Science*, organized by Dr. Marie Danforth (USM–Anthropology) and Dr. Gerald Mattson (USM–Polymer Science). The symposium included seven papers presented by faculty and graduate students from Anthropology, Criminal Justice, and Polymer Science. Presenters also came from the Mississippi Crime Lab in Jackson and Forrest General Hospital in Hattiesburg.

Our regular session included four paper presentations by undergraduates in sociology and psychology from USM and JSU, three paper presentations by graduate students in anthropology and criminal justice from USM, one faculty presentation in anthropology (USM) and one undergraduate poster presentation from Alcorn State University.

Three awards were given this year. Two undergraduates were co-recipients of this year’s Best Undergraduate Paper Presentation Award. Christopher Curtis, an undergraduate in psychology from Jackson State University, received the award for his paper titled, “*Gender Differences in Perceived Parental Approval of Sexual Behavior Among African American College Students*.” Jude Toche, an undergraduate in sociology from The University of Southern Mississippi, received the award for his

paper, "*Evolution and America: An Ideological Approach*." The Best Graduate Student Paper Presentation Award went to Erin Villarraga, a graduate student in Anthropology at The University of Southern Mississippi, for her paper, "*Measuring Coastal Environments Through the Health of Their People*." Special thanks is given to Dr. Pamela Banks, Department of Psychology, JSU, for sponsoring these awards.

At the divisional business meeting, Dr. Ann Marie Kinnell (USM–Sociology) and Dr. Pamela Banks (JSU–Psychology) agreed to remain as chair and vice-chair respectively of the division for 2003–2004.—Ann Marie Kinnell

Science Education

The most important information was the election of the new Vice chair for Science Education Division which was Dr. Shelia Brown, The University of Southern Mississippi. She is currently the Center for Oceans Sciences Education Excellence (COSEE) Scientist at the J.L. Scott Marine Education Center and Aquarium. She was previously the Head of the Science Department at Jeff Davis Campus, Gulf Coast Community College. e-mail:

shelia.brown@usm.edu. The new Chair, Science Education Division is Ms Aimée T. Lee, The University of Southern Mississippi, Hattiesburg, MS

Zoology and Entomology

The Zoology and Entomology Division met on the morning and afternoon of Friday, Feb 14, 2003. During this sixty-seventh annual meeting of MAS, twelve oral presentations were made, more than double the number for last year(five). and two poster presentations. This is evidence that faculty participation interest has increased considerably. In last year's report it was stated that effort would be made to involve more graduate and undergraduate students. This objective was achieved. About five oral papers were presented by graduate students and a poster, by an undergraduate student.. About 30 individuals attended the presentations. The papers presented were interesting and informative and generated several questions and pertinent comments.

During the business meeting, the question of initiating annual awards for the best student paper presentation was discussed . It was unanimously agreed that we start this as from year 2004. A motion was made that the present officers of the Division continue to serve in their respective capacities. The motion carried. So Dr. Alex. D.W. Acholonu of Alcorn State University , continues to serve as Chair of the Zoology and Entomology Division and Dr. Elgenaid Hamadain of Jackson State University, as the Vice-Chair. Membership of the Division increased with several new people signing up as members. I am deeply honored by being elected to serve again as the Chair of the Division.—Alex D. W. Acholonu.

MISSISSIPPI ACADEMY OF SCIENCES Sixty-seventh Annual Meeting—February 2003 Late and corrected abstracts

Cellular, Molecular and Developmental Biology

THE CONSTRUCTION OF PLASMID VECTOR ENCODING POLYPEPTIDE FOR DRUG DELIVERY TO CANCEROUS TISSUE

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Nonspecific action of chemotherapeutic drugs limit therapeutic effect in tumors. Other approaches such as surgery and radiotherapy also have limitations in treatment of cancer. Here, we have taken a targeted approach for delivery of the drug to tumor cells where the drug will be linked to a defined polypeptide carrier (Elastin like peptide, ELP) which have the property of physical phase transition at an

elevated temperature (Tt). This would allow to selectively accumulate the drug-polypeptide complex in tumor tissue under localized hyperthermic conditions. Following entry into cells the drug (oligodeoxynucleotide) will bind to the corresponding cancer causing message molecule to stop its signal for unregulated tumor growth. To achieve this objective a plasmid construct was made consisting of ELP codon sequence ligated to polylysine codon AT one end and a tripeptide (RGD) codon at the other end. After expression in a host cell polylysine (positively charged moiety) would attract the negatively charged drug, an oligodeoxynucleotide, to bind by electrostatic interaction. Systemic infusion of the designed complex would take it to tumor site where

tripeptide at one end of ELP will bind to integrin protein present in the millieu of the cancer cells. Integrin bound macromolecular carrier would then facilitate entry into tumor cells via integrin receptors present on their membranes.

Chemistry and Chemical Engineering

REAL-TIME MONITORING OF RING-OPENING BULK POLYMERIZATIONS OF ϵ -CAPROLACTONE USING FTIR SPECTROSCOPY

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The bulk polymerizations of ϵ -caprolactone (CL) were monitored via IR-spectroscopy. Each polymerization was conducted at 134°C. The initiators used were n-butanol (BuOH), ethylene glycol (EG), and 1,3-propane diol (PD). The amounts of initiator used varied according to the molecular weight targeted. The induction periods for EG and PD were observed and support the previous findings of our group. However, here we also see an induction period with BuOH. These induction periods were due to both heat transfer and the delayed formation of the stannous alkoxide. The data was supportive of the mechanism previously proposed by Penczek. This mechanism was previously confirmed by Sherman.

Health Sciences

A COMPARATIVE REVIEW OF LIFE TEC, PROGESA, AND DEFENSE BLOOD STANDARDIZATION SYSTEM (DBSS) BLOOD DONOR INFORMATION SYSTEMS (BDIS)

Johnathan Ware and Carolyn Beck*, University of Southern Mississippi, Hattiesburg, MS 39406

Blood donor information systems are used by blood collection agencies to track donor and blood product information. Ideally, these systems should improve efficiency and ensure regulatory compliance for the blood collection agency. The blood donor information systems utilized by United Blood Services (Progesa System), Mississippi Blood Services (Life Tec System), and Keesler Air Force Base (Defense Blood Standardization System) were reviewed in 2002. The following blood donor information systems processes were compared: 1. Creation of an electronic blood donor card. 2. Automatic deferral of the blood donor by the system. 3. Manual deferral of the blood donor. 4. Tracking of entire

blood preparation process. 5. Ability to create and track split/pooled blood products. 6. Ability to be utilized at mobile donor sites. 7. Ability to download viral marker test results performed off-site. 8. Ability to enter manual results for esoteric tests. 9. Each of the three information systems had advantages and disadvantages. The only blood donor information system that possessed the ability to complete all of the above tasks was the Progesa System utilized by United Blood Services in Meridian, Mississippi. Therefore, the Progesa System was judged to be the best of these three information systems.

Mathematics, Statistics and Computer Science

INTERPOLATING LARGE DATA SETS USING BERNSTEIN FUNCTIONS

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Bernstein functions represent an entirely new approach to functional approximation. These functions can be used to approximate and interpolate data, and in this study, we examine aspects of using interpolating Bernstein functions to represent and manipulate data in large data sets with regard to data compression, examining important numerical performance issues such as convergence, and oscillation for non-smooth, or rapidly varying data.

FAST BERNSTEIN FUNCTION INTERPOLATION

Joseph Kolibal, University of Southern Mississippi, Hattiesburg, MS 39406

The process of using Bernstein functions to interpolate data relies on a deconvolution process in which the pre-image of the data to be constructed is generated. For large data this requires the repeated inversion of a large matrix. To reduce the computational cost we demonstrate a technique for constructing an interpolating basis in which the interpolant can be determined rapidly by constructing a linear combination of basis elements.

USING INTERPOLATING BERNSTEIN FUNCTIONS FOR IMAGE PROCESSING

Jianxiang Qiao*, Yang Ye, and Joseph Kolibal, University of Southern Mississippi, Hattiesburg, MS 39406

Bernstein functions can be used to construct interpolants to data which are non-oscillatory, and provide a globally smooth interpolation of image

data. This technique is applied to image data to demonstrate how the technique may be used to zoom small raster images while minimizing the undesirable attributes of pixel based image data.

NUMERICAL SOLUTIONS TO STOCHASTIC PDES

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The Galerkin method is re-examined for elliptic PDEs of the form $Au = W$, where W is white-noise forcing. Following the traditional weak formulation, it is shown how one might interpret, and solve, the problem: For a given white noise W , find u in U (an appropriate space of random functions), such that $(u, A^*v)_H = \langle v, W \rangle$, $\forall v \in V$. The space V of test functions depends on both A and W . As in the deterministic setting, $H = L^2(G)$ plays an important role in the theory. Numerical solutions of the weak form are presented for several test cases, including some evolution equations.

STATISTICAL PROCESSING OF A DATABASE AND COMPUTER DIAGNOSTICS

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In the developed program I am using information contained in a database for the purposes of identifying the objects belonging to the certain class described by statistically steady combination of attributes. On the example of a database that contains patients in a medical establishment, is shown the way of solving the problem for the purpose of computer diagnostics of diseases. The diagnostic (the program) can easily be applied to any other life situation that needs statistical analysis and computer forecast of an expected or unexpected result. My

method based on the theory of probability can be applied to any establishment that has a database. It also can be used to predetermine different factors. I used the database containing the list of patients and the list of some attributes (symptoms) belonging to these patients. It was required to develop a program solving the problem of determination of belonging of a patient (a new patient, just entered to the database) to one of classes (diagnosis of illness) if individual attributes (symptoms) of this patient are known beforehand. In the other words, I created a program that will determine the diagnosis of the patient with entering only the symptoms that the patient has. That makes easier a further treatment and a task of a doctor who is drawing a conclusion about what illness a patient has.

ASP-BASED DATABASE DRIVEN ONLINE SURVEY

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Statistical data is widely used in all kinds of businesses. There are many ways to gather it as well. This presentation explains how using ASP & Microsoft Access databases the information can be gathered from the public online. The example shows an interactive survey used for statistical purposes that may serve as a useful application on a company website. It gathers information from users, stores it in a database, analyzes it, and then displays the results in a convenient way. This application can also be integrated into more complicated surveys or online testing systems. Currently this survey is up and running on Alcorn State University School of Business website. It helps with gathering statistical data from its students. The application was built using: HTML, MS Access, SQL, Macromedia Studio MX.

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