

THE QUANTITY AND QUALITY OF RAINFALL AT THE NATIONAL ATMOSPHERIC DEPOSITION SITE IN MIDDLE GEORGIA: 1979-1989

J.T. Walker and John Melin

AUTHORS: J.T. Walker and John Melin, Department of Plant Pathology, The University of Georgia College of Agriculture, Georgia Station, Griffin GA 30223-1797.

REFERENCE: *Proceedings of the 1991 Georgia Water Resources Conference*, held March 19 and 20, 1991 at The University of Georgia. Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia 1991.

INTRODUCTION

The National Atmospheric Deposition Network Program (NADP), established by various state and federal agencies, universities, and private industries, is now over 10 years old. The system was designed to provide needed information on the ionic constituents of precipitation, particularly pH, for the purpose of denoting spacial and temporal trends.

This report is a summary of data acquired over the past 11 years at the University of Georgia, College of Agriculture, Agricultural Experiment Station site as part of this national 200 site network. A more detailed report is available as a College of Agriculture Experiment Station Research Report No. 597 (in press).

METHODS

In October 1978 an Aerochem rainfall collector was established on the Bledsoe farm in Pike County, Georgia [latitude 33° 10' 40", longitude 84° 24' 22", Hollonville quadrangle] in accordance with the NADP guidelines. The collector was serviced every Tuesday morning at 9 a.m. by John Melin, the site operator, who weighed the amount of weekly rainfall collected, made pH and conductivity measurements, and kept precipitation records. Dry deposition did not effect the wet deposition results because the wet-side bucket of the collector remained covered except during precipitation periods.

The weekly samples from this and all other sites were analyzed for nine different ions at the Central Analytical Laboratory in the Illinois Natural History Survey, Champaign-Urbana, Illinois. These analyses included ammonium calcium, chloride, hydrogen, magnesium, nitrate, phosphate, potassium, sodium, and sulfate.

RESULTS AND IMPLICATIONS

Almost 90% of the 586 samples collected over this 11 year period were considered valid samples according to

NADP criteria. These samples represent 4,109 days and 1,260 cm of rain.

The lowest annual rainfall was recorded in 1986; a severe drought also occurred in 1985 (Table 1). In fact, eight of the last 11 years had total rainfall amounts averaging 12% less than the mean for the last 50 years (Kinard and Tippins, 1982). October was the driest month overall and February the wettest (data not included).

Table 1. Annual Precipitation Recorded at the NADP/NTN Site (Bledsoe Farm) from 1979-1989.

YEAR	CM
1979	129.62
1980	107.29
1981	97.37
1982	137.36
1983	120.33
1984	110.93
1985	105.20
1986	94.73
1987	105.94
1988	107.70
1989	121.30
MEAN	112.52

The annual volume-weighted mean pH varied from 4.4 in 1986 to 4.8 in 1983 (Table 2). The overall mean is pH 4.6. The minimum pH noted for an individual weekly sample was 3.4 in September, 1985; the maximum was 7.4 in May, 1984. No trends in pH changes are obvious. The annual deposition of the nine chemical ions received in the rain at the NADP site is shown in Table 3. The volume listed is the amount of rain deposited in the Aerochem collector, however, the deposition (mg/m^2) calculations were based on the amount recorded by the

TABLE 2. Annual Ionic Deposition from Rainfall at Bledsoe NADP/NTN Site (#114140) from 1979-1989.

YEAR	mg/m ²											VOLUME mls
	Ca	Mg	K	Na	NH ₄	NO ₃	Cl	SO ₄	PO ₄	H+		
1979	111.7	40.2	96.9	402.3	363.8	882.3	384.0	2143.0	65.0	28.1	82,979.2	
1980	122.0	35.6	105.1	395.2	198.8	1100.0	371.2	2321.1	19.8	37.4	79,002.5	
1981	148.7	51.5	96.2	160.9	243.5	880.2	320.3	2075.7	25.8	29.4	64,382.3	
1982	128.0	53.2	60.5	175.4	209.0	897.8	333.5	2193.9	56.8	34.6	87,197.7	
1983	132.9	41.8	94.9	188.7	228.4	739.0	333.9	1428.5	26.1	18.0	76,257.9	
1984	197.8	43.8	45.6	202.6	211.2	902.2	364.0	1685.4	7.2	28.8	68,498.8	
1985	71.7	28.9	42.7	134.7	142.6	847.0	262.8	1225.9	11.1	33.5	61,492.6	
1986	65.5	19.4	20.3	98.8	129.9	785.4	189.2	1679.2	13.2	30.6	54,769.9	
1987	72.7	24.2	47.8	133.6	167.4	891.1	255.6	2065.7	24.6	36.5	68,208.6	
1988	81.8	24.4	19.7	166.9	103.6	792.7	289.0	1726.2	25.9	32.4	70,705.6	
1989	88.4	27.1	84.1	146.4	376.4	873.7	268.6	1709.7	82.3	24.0	79,111.7	
MEAN	111.0	35.5	64.9	200.5	215.9	871.9	306.5	1841.3	32.5	30.3	72,055.2	

on-site Belfort rain gauge since it more accurately reflects the rainfall amount.

Middle Georgia rain contains more sulfate and nitrate ions than any other species. Sulfate averaged over 1,800 mg/m²/yr.; the lowest (1,225) amount deposited occurred in 1985; the greatest (2,321) in 1980. Nitrate averaged 872 mg/m₂/year. Converting these data to pounds per acre, sulfate is equivalent of 18.1 and nitrate to 8.6. Chloride, ammonium, sodium, calcium, potassium, magnesium, phosphate, and hydrogen ions, in descending order, all averaged less than 310 mg/m₂. The 11-year mean conductivity for all rain samples was 25.525 ± 4.145 (microsiemens/cm).

SUMMARY

The first NADP site in Georgia was established in October, 1978 at the Georgia Station's Bledsoe farm in Pike County for the purpose of determining the ionic concentrations of precipitation in middle Georgia.

The volume-weighted average pH of rain during the last 11 years was 4.6. Sulfate and nitrate comprised the

largest ionic components in rain averaging 1,800 and 870 mg/m² respectively, per year. Chloride ions averaged 307, all others were less ranging from 30 for H⁺ to 216 mg/m² for NH₄.

The information from the NADP network should provide a reference point for any changes which may occur in the quality of our rainfall, especially as environmental changes occur relative to legislative initiatives.

LITERATURE CITED

- Kinard, D.J., and H. H. Tippins. 1982. Weather data summary for the Georgia Experiment Station, 1926-81. University of Georgia, College of Agriculture, Experiment Stations Research Report 406. 51 pp.
- Walker, J. T., and J. Melin. 1991. Rainfall in Middle Georgia: Its pH and ionic constituents over the past eleven years with information on ozone, particulates, and fog. University of Georgia, College of Agriculture, Experiment Stations Research Report 597 (in press).

TABLE 3. Minimum, Mean, and Maximum pH and Conductivity of Weekly Rain Samples Collected at Georgia Station Bledsoe NADP/NTN Site between 1979-1989.

Year	pH ^a			Conductivity (micro S/cm)		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
1979	3.96	4.63	6.85	4.7	26.8	197.2
1980	3.75	4.49	7.10	6.6	28.2	149.8
1981	3.51	4.54	6.28	6.6	30.1	149.6
1982	3.61	4.58	6.42	4.8	22.0	135.4
1983	3.86	4.82	6.75	5.2	19.1	59.1
1984	3.90	4.55	7.00	4.5	20.8	57.4
1985	3.43	4.47	6.49	6.2	33.0	187.2
1986	3.73	4.43	6.32	5.1	28.1	90.5
1987	3.64	4.49	5.19	5.6	27.3	115.5
1988	3.64	4.52	5.68	3.4	23.6	101.1
1989	3.89	4.70	7.14	3.1	21.8	105.7

^a Concentration of H⁺ = $\sum[C_i \cdot \text{Precip}_i] / \sum[\text{Precip}_i]$, converted to pH