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Arkansas Soil Fertility Studies 1998

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SOIL FERTILITY STUDIES 1998

Wayne Sabbe, editor

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ARKANSAS SOIL FERTILITY STUDIES

–1998–

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INTRODUCTION

The 1998 Soil Fertility Studies includes research reports on numerous Arkansas commodities and on several research areas including several topics associated with precision agriculture. For more information on any included topic, please contact the author(s). Also included is a summarization of soil test data from samples submitted for the 1998 growing season. This includes data for counties, soil associations physiographic areas, and selected cropping systems.

Funding for the associated soil fertility research programs came from several commodity check-off funds, state, federal, the fertilizer industry institutes, and lime vendors. The fertilizer tonnage fee provided funds not only for soil testing but also for research and publication of this research series.

Thanks are extended to state and county extension staffs, staffs at extension and research centers and branch stations, farmers, and cooperators, and fertilizer industry personnel who assisted with the planning and execution of the programs.

Readers are reminded that the 1996 Arkansas Soil Fertility Studies Research Series 455 contains the index to articles in the previous Arkansas Soil Fertility Research Series.

This publication is available online at http://www.uark.edu/depts/agripub/Publications/researchseries/. Additional printed copies of this publication can be obtained free of charge from Communication Services, 110 Agriculture Building, University of Arkansas, Fayetteville, AR 72701.

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CONTENTS

SUMMARY

Rapid technological changes in crop management and production require that the research efforts also be presented in an expeditious manner. The contributions of soil fertility and fertilizers are major production factors in all Arkansas crops. The studies contained within will allow producers to compare their practices with the university's research efforts. Additionally, soil test data and fertilizer sales are presented to allow comparisons among years, crops, and other areas within Arkansas.

SOIL TEST AND FERTILIZER SALES DATA: SUMMARY FOR THE GROWING SEASON

–1998–

R.E. DeLong, S.D. Carroll, S.L. Chapman, W.E. Sabbe, and W.H. Baker

BACKGROUND INFORMATION

Soil test data from samples submitted by Arkansas farmers and growers to the University of Arkansas Soil Test Lab during the period 1 January 1998 through 30 August 1998 were categorized according to geographic area, county, soil association number (SAN) and selected cropping system. The period from 1 September 1997 through 31 December 1997 was not included due to data loss at the University of Arkansas Soil Test Lab. This sampling period roughly corresponds to the 1998 crop growing season; therefore, those samples should represent the soil fertility of that cropping season. The geographic area and SAN were from the General Soil Map, State of Arkansas (December 1982). The statistical interpretation of the soil test data included categorical ranges for pH, P, K, NO_3-N and soluble salts. Soluble salts and NO_3-N can be indexes for possible soil contents that may lead to adverse soil growing conditions or leaching potentials. Soil pH plus soil test (Mehlich III) values indicate the soil fertility level.

RESULTS

Crop Acreage and Soil Sampling Intensity

In the interval from 1 January 1998 through 30 August 1998, soil samples representing a total of 1,059,699 acres were submitted through the University of Arkansas Soil Testing Program (Tables 1-4). These 44,252 samples resulted in fertilizer and lime recommendations in all counties with each sample representing an average of 24 acres. Samples by geographic area were dominated by Bottom Land and Terrace and Loessial Plain, which also had the greatest acres / sample. The county average ranged from 3 to 52 acres / sample. The lowest county sample number was 14 and the highest county sample number was 2,310.

The average by SAN indicates the predominance of row crops and pasture. The higher values originate either from the Delta SAN where cotton, rice, wheat, and soybean prevail or from rangeland SAN where cool- and warm-season hay and pasture production occurs.

The crops involved indicate that, in addition to row crops and pasture, turf and garden enterprises contributed largely to the samples submitted to the program.

Soil Test Data

Values in Tables 5 to 8 pertain to the fertility status of the soils as categorized by geographic area, county, SAN or the suggested 1998 crop category. Soil test values relate to the fertility of a soil but not necessarily to the productivity of the soil. Therefore, it may not be realistic to compare soil test values among SAN without knowledge of location and cropping system. Likewise, county values need knowledge of SAN and the profile of cropping systems. Soil test data for cropping systems can be compared; however, the specific cropping systems dictated past fertilizer practices and, hence, current soil test values. For example, cotton has a history of intensive fertilization whereas dryland soybean has not been subjected to intensive fertilization. Similarly, rice can be produced on soils low in P and K, and those soil test values for the commodity reflect that fact. The acidity of Arkansas soils is demonstrated by the 13% sampled acreage that has a pH less than 5.5. From a beneficial standpoint, the accumulation of soluble salts and leachable nitrogen (NO_3-N) is low with 70 and 84% for each in the lowest category, respectively.

The predominant low and high soil test characteristics of the major land areas in the state reflect both natural and man-made occurrences. The most acidic soils occurred in the Ouachita Mountain (30% below pH 5.5). The most alkaline soils occurred in the Loessial Plain (41% above pH 6.50). The Loessial Plain samples reflect lime deposition from irrigation water. The high pH Blackland Prairie soils were naturally derived from calcitic chalk. The lowest phosphorus readings (below 45 lb / acre) occurred in soils from the Loessial Plain (67%), Loessial Hill (52%), Ozark Highland - Sandstone and Limestone (46%) and Blackland Prairie (44%). Soils highest in P (>300 lb / acre) were in the Ouachita Mountain (25%), Coastal Plain (24%) and Boston Mountain (23%). Soils lowest in K (below 176 lb / acre) were from the Coastal Plain (43%), Loessial Plain (41%) and Ouachita Mountain (38%). Soils lowest in Mg (below 151 lb / acre) were from the Boston Mountain (40%), Coastal Plain (33%) and Arkansas Valley and Ridge (31%). Bottom Land and Terrace soils were generally high in Mg (36% above 650 lb / acre). Soils low in sulfur (below 21 lb / acre) were from the Bottom Land and Terrace (62%) and Coastal Plain (40%). The Blackland Prairie soils were high in sulfur (28% above 40 lb / acre). Soils low in copper (below 3.1 lb / acre) were from the Loessial Plain and Loessial Hill (78%). Both Ozark Highlands and the Ouachita Mountain were high in copper with 13% greater than 12 lb / acre. Soils high in zinc (above 18 lb / acre) were from the Ozark Highland - Cherty Limestone and Dolomite and Ozark Highland - Sandstone and Limestone (33%), Ouachita Mountain (24%) and Boston Mountain (22%). Soils high in Mn (above 400 lb / acre) were both Loessial Hill (14%), Ozark Highlands (13%) and Boston Mountain (12%). Blackland Prairie was low in Mn (lower than 51 lb / acre) at 37%. A soil low in Zn (lower than 3.1 lb / acre) was Loessial Plain at 10%. Blackland Prairie at 43% was high in Ca (above 8000 lb / acre) with Coastal Plain low in Ca (lower than 1001 lb / acre) at 25%. Loessial Plain was high (35%) in Fe (above 400 lb / acre) with Blackland Prairie low (37%) in Fe (lower than 101 lb / acre).

Table 8 contains the median (Md) for each of the cropping system categories. The median—being the soil test value that has equal number of entities above and below—should be a better interpreter of a soil's fertility status than the percentage profile of the samples. Among row crops the lowest P and K median values appear for rice and irrigated soybeans. As expected, the highest P and K median values are for cotton. Fertilizer consumption by county and by form for the state (Tables 9-10) illustrate the wide use of fertilizer predominantly in row-crop counties and in bulk form.

PRACTICAL APPLICATION

The data can be viewed from the perspective of establishing a state-wide, county-wide, or commodity educational program on soil fertility and fertilization practices. The data are rather general, and more specific categories (e.g., soybean in Arkansas county for SAN 44) should be generated for those purposes. Comparisons and contrasts among counties, SAN, or cropping systems would give the specific data needed for these programs.

ACKNOWLEDGMENT

Financial support from the Arkansas Fertilizer Tonnage Fee is appreciated.

Table 1. Sample number and acreage by geographic area in Soil Test Program from January 1998 through August 1998.

Geographic Area	Acres Sampled	Number of Samples	Acres / Sample
Ozark Highland - Cherty Limestone and Dolomite	113,005	6,390	18
Ozark Highland - Sandstone and Limestone	5,782	358	16
Boston Mountain	35,278	2,514	14
Arkansas Valley and Ridge	95,717	5,515	17
Ouachita Mountain	33,889	4,340	8
Bottom Land and Terrace	360,793	11,655	31
Coastal Plain	50,071	3,431	15
Loessial Plain	349,253	9,028	39
Loessial Hill	13,814	907	15
Blackland Prairie	2,097	114	18

Table 2. Sample number and acreage by county in Soil Test Program from January 1998 through August 1998.

County	Acres Sampled	No. of Samples	Acres/ Sample	County	Acres Sampled	No. of Samples	Acres/ Sample
Arkansas(DE)	43,493	966	45	Lee	21,965	506	43
Arkansas(ST)	69,574	1,656	42	Lincoln	19,293	503	38
Ashley	15,682	568	28	Little River	7,192	162	44
Baxter	1,613	252	6	Logan (BO)	2,154	185	12
Benton	34,853	1,916	18	Logan (PA)	5,377	253	21
Boone	12,285	570	22	Lonoke	67,780	1,568	43
Bradley	769	150	5	Madison	9,070	649	14
Calhoun	77	14	6	Marion	1,213	102	12
Carrol1	14,284	669	21	Miller	4,795	269	18
Chicot	4,207	105	40	Mississippi (BL)	11,163	368	30
Clark	4,297	343	13	Mississippi (OS)	6,916	146	47
Clay (CO)	14,211	479	30	Monroe	20,138	445	45
Clay (PI)	16,832	621	27	Montgomery	1,791	138	13
Cleburne	7,303	300	24	Nevada	1,193	82	15
Cleveland	350	48	7	Newton	1,867	150	13
Columbia	2,819	255	11	Ouachita	322	91	4
Conway	9,166	424	22	Perry	6,230	272	23
Craighead	36,750	1,280	29	Phillips	15,489	575	27
Crawford	5,341	305	18	Pike	5,476	356	15
Crittenden	25,998	754	35	Poinsett	49,080	1,311	37
Cross	65,795	1,269	52	Polk	7,388	399	19
Dallas	1,179	36	33	Pope	14,163	764	19
Desha (DU)	2,211	62	36	Prairie (DA)	12,102	371	33
Desha (MC)	20,604	1,804	11	Prairie (DB)	8,910	324	28
Drew	1,896	158	12	Pulaski	6,380	1,794	4
Faulkner	5,143	434	12	Randolph	11,430	527	22
Franklin (CH)	203	25	8	Saline	1,540	275	6
Franklin (OZ)	10,908	311	35	Scott	2,596	193	14
Fulton	5,936	314	19	Searcy	8,267	427	19
Garland	4,810	1,403	3	Sebastian (FS)	1,171	369	3
Grant	253	92	3	Sebastian (GR)	3,470	214	16
Greene	25,869	1,210	21	Sevier	10,260	376	27
Hempstead	3,128	221	14	Sharp	847	133	6
Hot Spring	932	105	9	St. Francis	16,421	479	34
Howard	5,125	284	18	Stone	2,969	244	12
Independence	9,062	409	22	Union	1,409	256	6
Izard	4,690	318	15	Van Buren	3,274	292	11
Jackson	25,705	585	44	Washington	35,993	2,005	18
Jefferson	25,914	1,466	18	White	52,316	2,310	23
Johnson	3,701	254	15	Woodruff	13,977	313	45
Lafayette	8,295	246	34	Yell (DN)	4,495	270	17
Lawrence	29,748	1,062	28	Yell (DR)	806	43	19

Table 3. Sample number and acreage by Soil Association in Soil Test Program from January 1998 through August 1998.

Soil Association Number - Soil Association	Acres Sampled	No. of Samples	Acres/ Sample
1. Clarksville-Nixa-Noark	19,335	1,132	17
2. Gepp-Doniphan-Gassville-Agnos	11,821	903	13
3. Arkana-Moko	19,429	989	20
4. Captina-Nixa-Tonti	59,764	3,205	19
5. Captina-Doniphan-Gepp	265	29	9
6. Eden-Newnata-Moko	2,391	132	18
7. Estate-Portia-Moko	1,522	124	12
8. Brockwell-Boden-Portia	4,260	234	18
9. Linker-Mountainburg-Sidon	5,162	393	13
10. Enders-Nella-Mountainburg-Steprock	30,116	2,121	14
11. Falkner-Wrightsville	590	41	14
12. Leadvale-Taft	29,099	1,891	15
13. Enders-Mountainburg-Nella-Steprock	5,676	288	20
14. Spadra-Guthrie-Pickwick	1,592	82	19
15. Linker-Mountainburg	58,760	3,213	18
16. Carnasaw-Pirum-Clebit	13,571	2,121	6
17. Kenn-Ceda-Avilla	3,683	209	18
18. Carnasaw-Sherwood-Bismarck	10,896	1,734	6
19. Carnasaw-Bismarck	377	24	16
20. Leadvale-Taft	1,172	72	16
21. Spadra-Pickwick	4,190	180	23
22. Foley-Jackport-Crowley	80,269	2,428	33
23. Kobel	20,594	530	39
24. Sharkey-Alligator-Tunica	25,323	643	39
25. Dundee-Bosket-Dubbs	63,251	2,003	32
26. Amagon-Dundee	21,307	603	35
27. Sharkey-Steele	10,398	249	42
28. Commerce-Sharkey-Crevasse-Robinsonville	8,703	311	28
29. Perry-Portland	32,146	1,838	18
30. Crevasse-Bruno-Oklared	62	17	4
31. Roxana-Dardanelle-Bruno-Roellen	6,417	208	31
32. Rilla-Hebert	81,512	2,485	33
33. Billyhaw-Perry	3,326	90	37
34. Severn-Oklared	5,650	150	38
35. Adaton	776	43	18
36. Wrightsville-Louin-Acadia	724	39	19
37. Muskogee-Wrightsville-McKamie	335	18	19
38. Amy-Smithton-Pheba	5,881	147	40
39. Darco-Briley-Smithdale	966	55	18
40. Pheba-Amy-Savannah	3,249	448	7
41. Smithdale-Sacul-Savannah-Saffell	13,315	1,157	12
42. Sacul-Smithdale-Sawyer	12,536	1,081	12
43. Guyton-Ouachita-Sardis	14,124	543	26
44. Calloway-Henry-Grenada-Calhoun	209,388	5,881	36
45. Crowley-Stuttgart	139,865	3,147	44
46. Loring	1,825	58	32
47. Loring-Memphis	10,760	791	14
48. Brandon	1,229	58	21
49. Oktibbeha-Sumter	2,097	114	18

Table 4. Sample number and acreage by crop in Soil Test Program from January 1998 through August 1998.

Crop	Acres Sampled	No. of Samples	Acres/Sample
Soybean - dryland	63,962	1,797	36
Soybean - irrigated	373,313	8,918	42
Cotton	137,674	4,464	31
Rice	84,275	2,049	41
Wheat	9,789	288	34
Double-crop wheat-soybean - dryland	7,415	204	36
Double-crop wheat-soybean - irrigated	23,112	464	50
Warm season grass - establish	7,642	270	28
Warm season grass - maintain	97,776	4,366	22
Cool season grass - establish	3,153	143	22
Cool season grass - maintain	83,507	3,711	23
Grain sorghum	6,499	180	36
Corn	16,043	406	40
All garden	5,835	3,187	2
Turf and ground cover	8,032	4,819	2
Fruit and nut	1,804	452	4
Vegetable	92	26	4
Other	129,776	8,518	15

Table 5. Soil test data by geographic area from samples submitted from January 1998 through August 1998.

	pH			P (lb/acre)					K (lb/acre)				NO_3-N(lb/acre)			EC(umhos/cm)		
Geographic Area	<5.5	5.5-6.5	>6.5	<26	26-44	45-10	101-300	>300	<176	176-220	221-350	>350	<26	26-100	>100	<100	101-500	>500
	---- Percentage of Sampled Acreage ----																	
Ozark Highland - Cherty Limestone and Dolomite	12	66	22	5	9	22	35	29	2	1	27	40	66	29	5	45	53	2
Ozark Highland - Sandstone and Limestone	10	63	27	24	22	24	20	10	28	21	31	20	85	13	2	72	28	0
Boston Mountain	15	69	16	12	12	22	31	3	29	4	7	30	74	23	3	60	39	1
Arkansas Valley and Ridge	17	67	16	13	14	25	32	16	31	16	30	23	76	21	3	59	40	1
Ouachita Mountain	30	58	12	10	10	21	34	25	38	16	27	19	70	24	6	55	42	3
Bottom Land and Terrace	6	59	35	12	19	44	23	2	18	15	38	29	94	6	0	83	17	0
Coastal Plain	25	61	14	13	11	19	33	24	43	14	24	19	82	15	3	66	32	2
Loessial Plain	9	50	41	34	33	26	7	0	41	26	25	8	91	8	1	73	27	0
Loessial Hill	14	63	23	28	24	28	14	6	26	19	37	18	88	11	1	73	27	0
Blackland Prairie	13	63	24	31	13	18	25	13	31	14	22	33	74	22	4	56	44	0
Average	15	62	23	18	17	25	25	15	31	17	29	3	80	17	3	64	35	1

Table 6. Soil test data by county from samples submitted from January 1998 through August 1998.

	pH			P (lb/acre)					K (lb/acre)				NO$_3$-N(lb/acre)			EC(umhos/cm)		
Geographic Area	<5.5	5.5-6.5	>6.5	<26	26-44	45-100	101-300	>300	<176	176-220	221-350	>350	<26	26-100	>100	<100	101-500	>500
	------------------------- Percentage of Sampled Acreage -------------------------																	
Arkansas (DE)	4	38	58	32	39	23	5	1	33	31	29	7	95	4	1	76	24	0
Arkansas (ST)	7	57	36	44	27	22	6	1	39	25	23	13	94	6	0	77	22	1
Ashley	4	57	39	13	8	44	34	1	20	16	45	19	97	3	0	94	6	0
Baxter	4	37	59	7	12	20	33	28	19	9	32	40	71	22	7	37	58	5
Benton	15	68	27	3	5	16	39	37	18	11	27	44	66	28	6	44	54	2
Boone	8	70	22	6	11	31	37	15	25	15	26	34	72	25	3	53	46	1
Bradley	19	44	37	9	10	18	35	28	37	10	29	24	74	23	3	65	34	1
Calhoun	21	71	8	0	14	43	21	22	71	0	14	5	86	7	7	71	29	0
Carroll	7	70	23	2	5	18	34	41	11	10	24	55	49	43	8	28	68	4
Chicot	2	57	41	11	21	35	24	8	7	2	37	54	87	12	1	63	34	3
Clark	30	57	13	31	13	14	27	15	54	13	20	13	92	8	0	70	28	2
Clay (CO)	7	74	19	27	31	28	13	1	40	24	29	7	97	3	0	91	9	0
Clay (PI)	9	72	19	20	22	40	18	0	26	25	39	10	92	8	0	89	11	0
Cleburne	20	62	18	14	11	28	31	16	32	17	31	20	77	20	3	66	32	2
Cleveland	40	54	6	27	4	19	23	27	44	25	23	8	83	15	2	69	31	0
Columbia	19	64	17	4	10	16	48	22	50	20	22	8	88	12	0	76	23	1
Conway	23	67	10	22	16	20	23	19	40	12	22	26	85	12	3	74	25	1
Craighead	5	63	32	13	19	46	20	2	16	17	41	26	95	5	0	80	20	0
Crawford	18	59	23	11	14	25	32	18	33	13	29	25	74	22	4	56	42	2
Crittenden	9	59	32	2	13	62	22	1	2	4	34	60	95	5	0	87	13	0
Cross	3	33	64	27	37	31	4	1	36	24	23	17	97	3	0	68	32	0
Dallas	28	50	22	14	8	14	44	20	53	6	28	13	81	8	11	75	19	6
Desha (DU)	2	42	56	3	11	45	24	17	13	13	29	45	76	23	1	50	47	3
Desha (MC)	2	35	63	6	17	50	27	0	6	9	41	44	92	8	0	80	20	0
Drew	25	53	22	22	17	23	28	10	30	16	27	27	79	18	3	63	35	2
Faulkner	27	57	16	30	13	19	26	12	39	16	26	19	80	16	4	67	33	0
Franklin (CH)	24	60	16	16	20	20	12	42	32	8	28	32	60	20	20	56	28	6
Franklin (OZ)	16	70	14	7	12	29	34	18	31	19	26	24	80	19	1	67	33	0

continued

Table 6. Continued.

	pH			P (lb/acre)					K (lb/acre)				NO_3-N(lb/acre)			EC(umhos/cm)		
Geographic Area	<5.5	5.5-6.5	>6.5	<26	26-44	45-100	101-300	>300	<176	176-220	221-350	>350	<26	26-100	>100	<100	101-500	>500
	------------------------- Percentage of Sampled Acreage -------------------------																	
Fulton	5	63	32	9	15	38	32	6	19	12	33	36	82	15	3	56	44	0
Garland	40	51	9	10	11	23	32	24	42	14	26	18	53	34	13	42	50	8
Grant	38	49	13	24	14	20	26	16	37	19	33	11	88	12	0	70	29	1
Greene	10	69	21	20	30	31	18	1	36	20	30	14	95	4	1	88	11	1
Hempstead	20	67	13	9	8	21	37	25	43	18	20	19	83	14	3	68	32	0
Hot Spring	31	48	21	14	11	20	24	31	47	11	16	26	79	17	4	62	37	1
Howard	20	71	9	8	6	14	23	49	28	9	23	40	73	24	3	52	46	2
Independence	11	59	30	10	17	26	27	19	30	15	25	30	61	34	5	43	55	2
Izard	7	65	28	10	23	26	30	11	44	16	22	18	85	14	1	72	27	1
Jackson	9	67	24	24	26	33	16	1	30	25	38	7	93	5	2	83	16	1
Jefferson	33	46	21	21	19	33	23	4	39	14	29	18	82	17	1	75	25	3
Johnson	13	75	12	19	14	18	28	21	42	14	22	22	82	17	1	73	26	1
Lafayette	5	34	61	6	9	39	38	8	24	12	26	38	86	13	1	66	34	0
Lawrence	5	73	22	35	28	30	6	1	33	27	31	9	94	5	1	81	19	0
Lee	5	74	21	4	12	59	23	2	10	14	39	37	90	10	0	85	14	1
Lincoln	21	55	24	7	10	34	35	14	23	15	33	29	92	8	0	71	28	1
Little River	14	66	20	16	22	29	28	5	43	11	28	18	87	12	1	76	24	0
Logan (BO)	9	72	19	21	15	20	29	15	33	12	29	26	81	11	8	58	41	1
Logan (PA)	16	63	21	12	16	29	32	11	33	15	26	26	83	15	2	72	28	0
Lonoke	8	71	21	23	26	34	15	2	26	22	34	18	95	5	0	85	15	0
Madison	12	81	7	6	9	17	39	29	14	11	33	42	81	18	1	58	42	0
Marion	9	61	30	5	24	33	28	10	13	17	36	51	72	24	4	47	50	3
Miller	17	66	17	10	14	30	33	13	37	11	22	30	78	20	2	57	41	2
Mississippi (BL)	4	66	30	0	1	41	53	5	4	8	53	35	92	8	0	87	13	0
Mississippi (OS)	1	83	16	1	3	73	23	0	5	11	49	35	95	4	1	90	10	0
Monroe	8	56	36	28	30	32	9	1	22	21	40	17	89	9	2	65	33	2
Montgomery	38	56	6	7	12	18	33	30	37	12	23	28	62	33	5	54	44	2
Nevada	26	67	7	15	16	13	37	19	46	26	16	12	83	15	2	73	27	0

continued

Table 6. Continued.

	pH			P (lb/acre)					K (lb/acre)				NO_3-N(lb/acre)			EC(umhos/cm)		
Geographic Area	<5.5	5.5-6.5	>6.5	<26	26-44	45-100	101-300	>300	<176	176-220	221-350	>350	<26	26-100	>100	<100	101-500	>500
	---------- Percentage of Sampled Acreage ----------																	
Newton	21	63	16	5	11	33	37	14	32	13	27	28	64	32	4	51	48	1
Ouachita	10	74	16	10	6	19	52	13	63	9	18	10	92	6	2	79	19	2
Perry	28	65	7	28	11	18	27	16	53	12	18	17	85	12	3	80	19	1
Phillips	7	58	35	3	21	55	20	1	14	19	39	28	85	13	2	77	23	0
Pike	26	64	10	7	14	14	24	41	46	13	24	17	76	22	2	60	39	1
Poinsett	1	28	71	34	35	25	5	1	49	25	22	4	95	4	1	62	37	1
Polk	27	66	7	5	7	19	39	30	40	15	21	24	81	17	2	71	28	1
Pope	17	70	13	12	13	22	28	25	35	13	28	24	82	15	3	68	31	1
Prairie (DA)	3	66	31	24	43	26	5	2	42	28	26	4	95	5	0	85	15	0
Prairie (DB)	5	61	34	57	27	11	1	4	45	21	22	12	92	7	1	71	29	0
Pulaski	24	56	20	9	10	22	35	24	29	20	32	19	77	20	3	54	44	2
Randolph	4	62	34	27	29	30	10	4	35	21	29	15	88	9	3	72	27	1
Saline	20	63	17	14	9	21	27	29	41	15	28	16	77	20	3	61	37	2
Scott	24	59	17	20	14	11	44	11	29	14	26	31	71	25	4	55	43	2
Searcy	28	64	8	8	12	33	38	9	33	15	25	27	75	22	3	65	34	1
Sebastian (FS)	19	63	18	9	8	26	30	27	24	16	36	24	56	35	9	38	57	5
Sebastian (GF)	11	76	13	23	19	15	26	17	37	17	25	21	81	18	1	61	39	0
Sevier	19	74	7	7	7	14	39	33	33	10	23	34	77	20	3	60	40	0
Sharp	4	44	52	10	16	27	31	16	11	17	33	39	64	31	5	33	65	2
St. Francis	12	53	35	25	23	35	14	3	27	23	31	19	88	10	2	74	26	0
Stone	10	77	13	7	12	18	30	33	22	16	31	31	74	23	3	58	41	1
Union	18	64	18	6	6	22	39	27	42	21	27	10	83	15	2	70	28	2
Van Buren	28	64	8	12	12	26	35	15	31	21	24	24	68	28	4	54	45	0
Washington	12	69	19	6	9	20	34	31	29	11	25	35	63	33	4	47	52	1
White	15	66	19	15	21	29	28	7	33	18	31	18	76	22	2	58	41	1
Woodruff	5	79	16	21	24	42	13	0	29	20	40	11	86	13	1	74	26	0
Yell (DN)	19	74	7	17	10	18	29	26	38	16	21	25	82	16	2	64	35	1
Yell (DR)	12	79	9	19	19	21	28	13	28	26	30	16	84	16	0	77	23	0
Average	15	62	23	15	16	27	27	15	32	16	28	24	82	16	2	66	32	2

Table 7. Soil test data by soil association number from samples submitted from January 1998 through August 1998.

Soil Association	PH			P (lb/acre)					K (lb/acre)				NO_3-N(lb/acre)			EC(umhos/cm)		
Number-Soil Association	<5.5	5.5-6.5	>6.5	<26	26-44	45-100	101-300	>300	<176	176-220	221-350	>350	<26	26-100	>100	<100	101-500	>500
	Percentage of Sampled Acreage																	
1. Clarksville-Nixa-Noark	14	69	17	4	8	27	37	24	21	13	29	37	67	30	3	46	52	2
2. Gepp-Doniphan-Gassville-Agnos	5	55	40	10	17	29	28	16	18	12	32	38	75	20	5	48	50	2
3. Arkana-Moko	7	69	24	5	11	21	33	30	22	12	23	43	61	33	6	42	55	3
4. Captina-Nixa-Tonti	14	68	18	3	6	18	37	36	22	11	26	41	65	30	5	43	55	2
5. Captina-Doniphan-Gepp	10	55	35	24	7	38	21	10	21	14	28	37	83	14	3	45	52	3
6. Eden-Newnata-Moko	22	71	7	8	13	34	39	6	34	17	28	21	74	23	3	63	37	0
7. Estate-Portia-Moko	15	66	19	5	11	28	34	22	24	14	32	30	77	19	4	62	38	0
8. Brockwell-Boden-Portia	8	62	30	34	28	21	12	5	30	25	31	14	89	9	2	77	23	0
9. Linker-Mountainburg-Sidon	15	59	26	10	10	27	27	26	28	17	26	29	69	27	4	51	47	2
10. Enders-Nella-Mountainburg-Steprock	15	71	14	12	13	21	32	22	29	14	27	30	75	22	3	62	37	1
11. Falkner-Wrightsville	27	71	2	24	20	29	20	7	46	15	24	15	83	17	0	78	22	0
12. Leadvale-Taft	18	63	19	15	12	22	32	19	30	16	30	24	74	22	4	56	42	2
13. Enders-Mountainburg-Nella-Steprock	18	72	10	16	16	27	27	14	33	14	32	21	76	17	7	66	32	2
14. Spadra-Guthrie-Pickwick	18	66	16	16	9	18	38	19	33	18	22	27	83	9	8	60	38	2
15. Linker-Mountainburg	16	69	15	11	15	27	32	15	32	17	30	21	76	22	2	59	40	1
16. Carnasaw-Pirum-Clebit	25	58	17	10	10	22	35	23	33	18	30	19	76	21	3	56	43	1
17. Kenn-Ceda-Avilla	18	73	9	6	10	12	39	33	36	15	22	27	84	14	2	67	33	0
18. Carnasaw-Sherwood-Bismarck	37	54	9	8	10	21	33	28	43	13	25	19	59	31	10	48	45	7
19. Carnasaw-Bismarck	17	58	25	0	17	33	29	21	38	17	21	24	71	29	0	46	54	0
20. Leadvale-Taft	11	85	4	15	17	24	32	12	53	13	17	17	90	8	2	79	21	0
21. Spadra-Pickwick	28	63	9	34	14	20	23	9	56	14	17	13	89	8	3	82	17	1
22. Foley-Jackport-Crowley	5	72	23	29	31	31	8	1	33	26	32	9	95	4	1	83	17	0

continued

Table 7. Continued.

Soil Association	PH			P (lb/acre)					K (lb/acre)				NO$_3$-N(lb/acre)			EC(umhos/cm)		
Number- Soil Association	<5.5	5.5- 6.5	>6.5	<26	26- 44	45- 100	101- 300	>300	<176	176- 220	221- 350	>350	<26	26- 100	>100	<100	101- 500	>500
	-- Percentage of Sampled Acreage --																	
23. Kobel	6	69	25	21	32	30	15	2	22	19	43	16	93	7	0	86	14	0
24. Sharkey-Alligator-Tunica	5	62	33	5	18	62	15	0	2	5	22	71	94	6	0	78	22	0
25. Dundee-Bosket-Dubbs	7	59	34	8	15	49	28	0	16	15	43	26	96	4	0	89	11	0
26. Amagon-Dundee	5	72	23	6	7	38	46	3	12	12	48	28	90	9	1	85	15	0
27. Sharkey-Steele	4	67	29	4	14	64	16	2	2	5	29	64	97	2	1	78	22	0
28. Commerce-Sharkey-Crevasse-Robinsonville	1	46	53	1	12	66	18	3	4	5	25	66	92	7	1	79	21	0
29. Perry-Portland	5	39	56	11	20	45	23	1	9	10	36	45	90	10	0	76	24	0
30. Crevasse-Bruno-Oklared	29	71	0	18	6	18	47	11	35	12	35	18	100	0	0	82	18	0
31. Roxana-Dardanelle-Bruno-Roellen	19	66	15	20	12	32	20	16	36	15	22	27	79	18	3	64	34	2
32. Rilla-Hebert	6	58	36	411	50	33	2	16	13	45	26	96	4	0	89	11	0	
33. Billyhaw-Perry	3	33	64	11	17	48	24	0	17	6	13	64	90	9	1	54	46	0
34. Severn-Oklared	3	38	59	7	13	47	32	1	31	15	32	22	89	11	0	78	22	0
35. Adaton	5	77	18	33	28	26	9	4	26	16	51	7	86	14	0	86	14	0
36. Wrightsville-Louin-Acadia	5	82	13	33	21	18	23	5	31	33	23	13	97	3	0	77	23	0
37. Muskogee-Wrightsville-McKamie	39	44	17	11	17	17	33	22	11	22	44	23	61	33	6	33	67	0
38. Amy-Smithton-Pheba	20	47	33	17	18	25	27	13	45	12	27	16	88	8	4	76	23	1
39. Darco-Briley-Smithdale	6	89	5	9	7	6	51	27	62	20	11	7	91	9	0	78	22	0
40. Pheba-Amy-Savannah	41	46	13	23	13	16	30	18	50	13	21	16	82	16	2	61	36	3
41. Smithdale-Sacul-Savannah-Saffell	24	60	16	12	11	18	32	27	43	15	24	18	82	16	2	66	32	2
42. Sacul-Smithdale-Sawyer	24	62	14	12	10	24	34	20	43	15	24	18	82	15	3	67	31	2
43. Guyton-Ouachita-Sardis	21	73	6	9	9	16	34	32	34	12	26	28	82	16	2	65	35	0

continued

Table 7. Continued.

Soil Association	PH			P (lb/acre)					K (lb/acre)				NO_3-N(lb/acre)			EC(umhos/cm)		
Number- Soil Association	<5.5	5.5- 6.5	>6.5	<26	26- 44	45- 100	101- 300	>300	<176	176- 220	221- 350	>350	<26	26- 100	>100	<100	101- 500	>500
	---------- Percentage of Sampled Acreage ----------																	
44. Calloway-Henry-Grenada-Calhoun	11	47	42	30	32	28	8	2	43	24	24	9	90	10	0	70	30	0
45. Crowley-Stuttgart	6	55	39	40	33	21	5	1	36	28	26	10	95	5	0	79	21	0
46. Loring	19	66	15	19	36	24	17	4	48	22	17	13	81	16	3	71	29	0
47. Loring-Memphis	15	63	22	29	23	29	13	6	25	17	39	19	87	11	2	72	27	1
48. Brandon	2	64	34	22	38	19	14	7	26	38	26	10	100	0	0	81	19	0
49. Oktibbeha-Sumter	13	63	24	31	13	18	25	13	31	14	22	33	74	22	4	56	44	0
Average	14	63	23	15	16	29	27	13	30	16	28	26	83	15	2	67	32	1

Table 8. Soil test data by crop from samples submitted from September 1996 through August 1997.

Geographic Area	pH				P (lb/acre)						K (lb/acre)					NO_3-N (lb/acre)				EC (umhos/cm)			
	<5.5	5.5-6.5	>6.5	Md[z]	<26	26-44	45-100	101-300	>300	Md	<176	176-220	221-350	>350	Md	<26	26-100	>100	Md	<100	101-500	>500	Md
	Percentage of Sampled Acreage																						
Soybean - dryland	12	65	23	6.1	21	27	40	12	0	46	31	21	30	8	216	95	5	0	7	90	10	0	59
Soybean - irrigated	4	51	45	6.5	29	36	31	4	0	35	35	24	25	16	200	97	3	0	7	81	19	0	74
Cotton	3	59	38	6.4	1	4	55	40	0	91	3	10	53	34	31	96	4	0	7	92	8	0	60
Rice	8	53	39	6.4	45	32	20	3	0	28	43	25	22	10	187	93	7	0	7	53	47	0	96
Wheat	20	60	20	5.9	14	27	41	18	0	52	29	23	37	11	214	81	18	1	10	73	27	0	76
Double-crop wheat-soybean - dryland	7	72	21	6.0	4	17	60	19	0	66	23	25	37	15	226	87	10	3	9	83	16	1	62
Double-crop wheat-soybean - irrigated	1	58	41	6.4	10	26	55	9	0	54	28	23	35	14	219	93	6	1	8	83	17	0	67
Warm season grass - establish	18	67	15	6.0	12	17	25	27	19	81	27	17	33	23	239	77	20	3	10	63	37	0	84
Warm season grass - maintain	17	72	11	5.9	9	10	22	30	29	134	33	15	25	27	229	76	22	2	12	63	37	0	84
Cool season grass - establish	11	73	16	5.9	11	13	23	35	18	116	25	11	32	32	275	70	25	5	15	54	46	0	96
Cool season grass - maintain	15	73	12	5.9	7	11	24	36	22	132	27	13	26	34	267	69	27	4	15	53	46	1	96
Grain sorghum	14	66	20	6.2	22	28	41	9	0	44	29	23	31	17	21	96	3	1	5	90	10	0	57
Corn	5	70	25	6.2	14	21	43	21	1	63	20	23	34	23	242	93	5	2	6	89	11	0	63
All garden	10	50	40	6.4	4	6	14	31	45	267	16	10	25	49	341	63	29	8	17	41	55	4	117
Turf and ground cover	24	57	19	6.0	7	10	25	45	13	122	30	17	35	18	229	67	27	6	14	48	49	3	102
Fruit and nut	30	54	16	5.8	11	13	32	31	13	88	39	13	23	25	212	79	17	4	10	64	33	3	79
Vegetable	14	77	9	5.9	4	15	23	46	12	114	27	15	46	12	234	92	8	0	11	77	23	0	64
Other	24	63	13	5.9	20	16	22	26	16	73	38	15	25	22	212	80	18	2	10	63	36	1	82
Average	13	63	24		14	18	33	25	10		28	18	32	22		84	14	2		70	29	1	

[z] Md = median; number is actual value, not the percentage.

Table 9. Fertilizer sold in Arkansas counties from 1 July 1997 through 30 June 1998.

County	Total	County	Total
	ton		ton
Arkansas	106,093	Lee	29,235
Ashley	41,407	Lincoln	30,182
Baxter	2,142	Little River	2,320
Benton	9,112	Logan	4,537
Boone	9,069	Lonoke	52,421
Bradley	1,961	Madison	7,217
Calhoun	507	Marion	1,241
Carroll	3,978	Miller	6,029
Chicot	19,478	Mississippi	77,937
Clark	3,820	Monroe	50,224
Clay	51,122	Montgomery	1
Cleburne	4,960	Nevada	3,605
Cleveland	30	Newton	348
Columbia	1,236	Ouachita	189
Conway	7,960	Perry	2,032
Craighead	62,474	Phillips	66,386
Crawford	9,834	Pike	1,145
Crittenden	30,827	Poinsett	83,538
Cross	67,161	Polk	2,862
Dallas	4	Pope	4,074
Desha	55,075	Prairie	43,373
Drew	6,101	Pulaski	21,311
Faulkner	8,323	Randolph	22,530
Franklin	3,636	St. Francis	48,315
Fulton	3,676	Saline	2,116
Garland	1,108	Scott	313
Grant	343	Searcy	6,058
Greene	30,927	Sebastian	2,390
Hempstead	4,883	Sevier	22,394
Hot Spring	2,823	Sharp	1,837
Howard	4,146	Stone	2,992
Independence	13,065	Union	974
Izard	3,274	Van Buren	8,284
Jackson	45,339	Washington	5,264
Jefferson	47,734	White	28,236
Johnson	1,766	Woodruff	37,817
Lafayette	6,479	Yell	2,144
Lawrence	33,678		

Table 10. Fertilizer sold in Arkansas from 1 July 1997 through 30 June 1998.

Fertilizer	Bulk	Bag	Fluid	Total
	----------------------------------	ton	----------------------------------	
Mixed	435,465	49,314	31,952	516,731
Nitrogen	590,305	6,232	158,151	754,689
Phosphate	18,447	97	34	18,579
Potash	58,868	1,111	296	60,274
Other	31,212	5,514	414	37,140
Total	1,134,297	62,269	190,847	1,387,413

MEETING NITROGEN REQUIREMENTS IN COTTON USING A PROGRAMMED RELEASE SOIL FERTILIZER

Adele Steger and Derrick Oosterhuis

RESEARCH PROBLEM

Current fertilizer practices involve applying fertilizer to the soil at or prior to planting with an additional application early in the growing season. A programmed release fertilizer increases efficiency by releasing nutrients according to crop requirements, while at the same time reducing traffic across the field. The objective of the current research was to evaluate a polyolefin-coated, Meister programmed release nitrogen (MPR N) fertilizer with regard to placement of fertilizer in the row or surface banded over the row, and application timing. This fertilizer product was designed to release nitrogen (N) in response to increasing soil temperatures during the growing season, coinciding with increasing crop nutrient requirements. The product has the potential advantages of: (a) providing a single fertilizer application, (b) customizing fertilizer application according to crop requirements for increased efficiency, and (c) providing a more efficient return per dollar spent on fertilizer. Asset RTU was applied in-furrow at planting to two of the treatments (2 x 2 and 2 x 12) to evaluate its effect in combination with MPR N. Asset RTU is a root stimulant that has been shown to effective in increasing early season root growth in cotton.

BACKGROUND INFORMATION

Fertilizer management is an important component of successful cotton production. Nitrogen is required in an increasing accumulative amount during the season for optimum growth and development. Traditionally, N fertilizer is applied at planting and sidedressed at early squaring. Due to potential problems with leaching and salinity during seedling growth, the entire amount of conventional fertilizer is seldom applied at planting. MPR N fertilizer, applied in-furrow at planting, is designed to increase nutrient availability in accordance with soil temperatures and seasonal demand. This study was designed to provide a continued field evaluation of MPR N soil-applied fertilizer used in combination with Asset RTU for their effects on lint yield in cotton production. Previous studies from 1996 and 1997 showed a trend towards numerically higher (4%) lint yields in both years in the treatment receiving 80% MPR N when compared with the 100% N control treatment. In 1997, lint yield was significantly higher (P=0.05) in the 80% MPR N treatment compared with the 100% conventional N treatment (Oosterhuis and Steger, 1997).

RESEARCH DESCRIPTION

The study was conducted in 1998 at the Delta Branch Station in Clarkedale. The cotton cultivar, Suregrow 125, was planted into a moderately well-drained Dundee silt loam soil on 6 May 1998. Plots consisted of four rows spaced 38 inches apart and 50 ft in length with seven replications. Insect and weed control were according to standard cotton recommendations. The trial was furrow irrigated as needed. Petioles from the uppermost fully-expanded leaves were sampled at pinhead square, first flower, and three weeks after first flower, and analyzed for nitrogen. Maximum and minimum air temperatures, and soil temperature at the 6-inch depth were recorded daily. The center two rows of each plot were machine harvested at approximately 60% open boll. Fertilizer treatments are listed in Table 1.

RESULTS

Lint yield results from 1998 were confounding and difficult to interpret. Yield was significantly higher in plots receiving MPR N at pinhead square when compared with treatments receiving split applications of N as NH_4NO_3 fertilizer or no application of N. This yield increase may have been due to the availability of N when the plant requirement for N was greatest. When MPR N was applied in a 2 x 2 placement with the addition of Asset RTU, there was a nonsignificant 6% increase in yield when compared with the same application without Asset RTU.

PRACTICAL APPLICATIONS

MPR N is a potential alternative N source in field cotton production. Although results from 1998 were variable, there was evidence in 1996 and 1997 (Oosterhuis and Steger, 1998) that N fertilizer inputs could be reduced by as much as 40% with MPR N without resulting in a lint yield decrease below that of the conventionally applied fertilizer. Other potential advantages included the potential to decrease groundwater contamination, increase nutrient uptake efficiency, and reduce field traffic.

REFERENCE

Oosterhuis, D.M. and A. Steger. 1998. Meeting nitrogen and potassium requirements in cotton using a programmed release soil fertilizer. *In:* Wayne E. Sabbe (ed.) Arkansas Soil Fertility Studies 1997. Arkansas Agricultural Experiment Station Research Series 459:72-75.

ACKNOWLEDGMENT

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Table 1. Treatments for evaluating MPR N fertilizer with and without Asset RTU in 1998.

Treatment	Rate	Placement	Timing
NH_2NO_3	100 lb N/acre (split)	In-furrow	At planting
		Broadcast	Pinhead square
MPR N	80 lb N/acre	Incorporated into soil	Prior to planting
MPR N	80 lb N/acre	on 1 April 1998	
MPR N	80 lb N/acre	2 x 2[z]	At planting
MPR N	80 lb N/acre	2 x 12[y]	At planting
MPR N plus	80 lb N/acre	4-inch band	Pinhead square
Asset RTU	2 pt/acre	in-furrow	At planting
MPR N plus	80 lb N/acre	2 x 12	At planting
Asset RTU	2 pt/acre	in-furrow	At planting
Control	no N added	---------	---------

[z] 2 inches to the side of the row and 2 inches deep.

[y] 12 inches to the side of the row and 2 inches deep.

Table 2. Effect of MPR N fertilizer on lint yield in 1998.

Treatment	Lint Yield	Boll Weight	Gin Turnout
	lb/acre	g/boll	%
NH_4NO_3	804	5.07	36.3
MPR N (1 April)	883	4.61	39.8
MPR N (2 x 2)	820	4.67	38.6
MPR N (2 x 12)	830	4.97	37.6
MPR N (pinhead square)	860	4.79	38.9
MPR N (2 x 2 plus RTU)	884	5.11	37.9
MPR N (2 x 12 plus RTU)	831	5.14	37.5
Control (no N applied)	762	4.63	38.8
C.V.	9.4	3.8	1.56
$LSD_{(0.05)}$	101.7	0.44	0.01

EFFECT OF FOLIAR-APPLIED CORON AND UREA ON PHYTOTOXICITY AND YIELD OF COTTON

Derrick Oosterhuis and Adele Steger

RESEARCH PROBLEM

Foliar fertilization with nitrogen (N) is a widely used practice in the U.S. Cotton Belt, but there have been some recent reports of poor responses to N fertilizer foliar applied later than three weeks after first flower. The introduction of slow release N fertilizers such as CoRoN may solve these problems by improving the adherence of the foliar-applied N to the leaf and thereby decreasing volatile losses and improving leaf uptake of applied N. However, information is lacking on the phytotoxicity properties of CoRoN compared to urea.

BACKGROUND INFORMATION

Foliar feeding in cotton has gained wide acceptance across the Cotton Belt due to the rapid and efficient response to plant nutrient requirements. However, the response to foliar N fertilization has been shown to decrease three weeks after first bloom (Keisling et al., 1995). Part of this lack of response is due to an increase in canopy leaf age and wax content of the cotton leaf cuticle (Bondada et al., 1994). Research has demonstrated that 30-70% of urea N can be lost to the atmosphere depending on field conditions. A possible solution to this dilemma is to use a controlled release N source that is released slowly to the plant for absorption into the leaf. CoRoN is a slow release nitrogen (CRN) liquid fertilizer that contains 40% CRN and 60% foliar urea. It is a combination of long chain polymethylene urea coupled with fast release low biuret urea. This combination provides a foliar fertilizer that can be used as an N source for increased leaf absorption and improved yield potential. CoRoN can be applied at higher rates compared to conventional foliar fertilizers without concern for leaf burn. Research in Arkansas, California, and Texas has shown some significant yield increases from mid-season foliar applications of CoRoN (Morse et al., 1997). The objective of this study was to collect data on the phytotoxicity of CoRoN and urea foliar fertilizers.

RESEARCH DESCRIPTION

The field study was conducted in 1998 at the Delta Branch Station in Clarkedale on a moderately well-drained Dundee silt loam. The cultivar Suregrow 125 was planted on 7 May 1998 in plots consisting of two rows spaced 38 inches apart and 25 ft in length. The trial was furrow irrigated as needed. The statistical design was a split plot with four replications. The two N sources were CoRoN (25% N) (Helena Chemical, Memphis, Tennessee) and solution urea (23% N). Both were applied in split plots at rates of 0, 5, 10, 15, 20, 25, and 30 lb N/acre. All foliar applications were made with a CO_2 backpack sprayer using a spray volume of 10 gallons of water per acre. The CoRoN and urea treatments were applied twice, on 5 August and 25 August 1998. Phytotoxicity was rated at varying times after application using a scale of “0” (no foliar burn) and “10” (severe foliar burn on the majority of the leaf). The plots were machine harvested at approximately 60% open boll.

RESULTS

Foliar Burn

CoRoN treated plants showed no visual symptoms of foliar burn (i.e. <5%) up to a rate of 20 lb N/acre (Fig. 1). At 25 lb N/acre the CoRoN treated plants exhibited about 10% leaf damage. In contrast, urea treated plants showed leaf burn (i.e. about 20%) at 10 lb N/acre and the phytotoxicity increased with increasing N rates with over 30% leaf burn at 25 lb N/acre. Any leaf burn can cause concern because of possible reductions in photosynthesis and membrane integrity within the leaf.

Lint Yield

There were no significant differences in yield between the two foliar N fertilizers (Table 1). The average yield was 729 lb lint/acre for both CoRoN and urea. This was to be expected as the trial was not designed to compare foliar-applied CoRoN to urea for effect on yield. The treatments were applied much later in the growing season than if the test was evaluating yield enhancement. The two N sources were applied in split plots at varying rates to gain information on their potential to cause leaf burn. Previously, a four-year study in Arkansas suggested an average yield advantage with CoRoN of 28 lb lint/acre (Morse et al., 1997).

PRACTICAL APPLICATIONS

CoRoN has been shown to be relatively safe as an N source for foliar fertilization with very little phytotoxicity even at rates three times the recommended N value. By comparison, foliar-applied urea caused significant leaf burn at rates above 10 lb N/acre. Therefore, if foliar rates of N higher than 10 lb/acre are required by a cotton crop late in the season, CoRoN is a potential N source.

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Table 1. Effect of varying rates of foliar-applied CoRoN and urea on lint yield of field-grown cotton.

Foliar Fertilizer	Rate	Lint Yield
	lb N/acre	lb/acre
Untreated control	0	547
CoRoN	10	580
	15	596
	20	677
	25	533
Liquid urea	10	569
	15	567
	20	677
	25	498
$LSD_{(0.05)}$		175.4

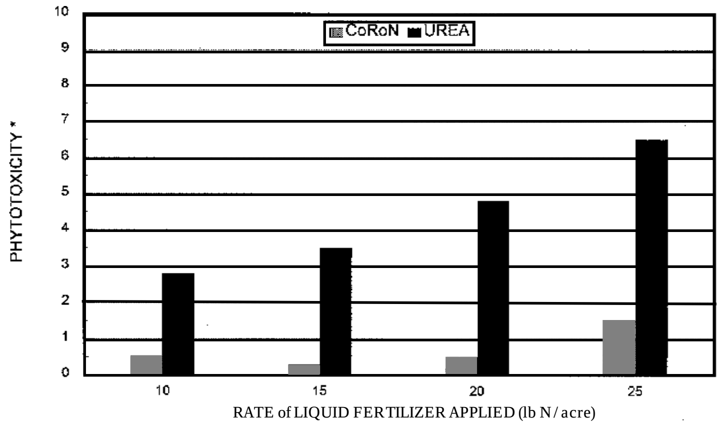

Fig. 1. Effect of varying rates of foliar-applied CoRoN and urea on the phytotoxicity of field-grown cotton four days following the first foliar spray application. *Phytotoxicity was rated 0 (no leaf burn) to 10 (complete foliar burn).

NITROGEN FERTILIZATION PRACTICES FOR ULTRA-NARROW-ROW COTTON: A PILOT STUDY

J.S. McConnell and R.C. Kirst, Jr.

RESEARCH PROBLEM

Ultra-narrow-row cotton (*Gossypium hirsutum* L.) represents a unique development in cotton production for Arkansas. Ultra-narrow-row (UNR) cotton is a drill-planted, stripper-harvested, non-irrigated, low-input production system designed to maximize economic returns. Research that provides information on production parameters is scant. Optimum nitrogen (N) fertilization rates and how UNR cotton utilizes N are unknown. The objective of this pilot study was to determine how UNR cotton respond to N fertilization.

BACKGROUND INFORMATION

Recently, interest in UNR cotton production has increased. It has long been known that plants grown in very narrow rows intercept and utilize sunlight more efficiently than plants in conventional rows. Potential benefits of UNR cotton production include reduced production costs (irrigation, insecticide application, and harvest equipment), use of poorer soils, decreased soil erosion, and use of the same equipment for cotton, soybeans, and cereal crops. Potential drawbacks of UNR cotton include the following: increased weed pressure in low stand areas, different equipment is required (precision drill planter, finger stripper harvester), and lint quality may decline. Variety differences, fertility requirements, effect of planting date, and other production parameters for optimum growth and yield of UNR cotton should be researched.

RESEARCH DESCRIPTION

A block of UNR cotton was drill-planted (John Deere Model 750 drill) on 19 May 1997 at the Southeast Branch Experiment station at Rohwer. Fertilizer treatments of 100 lb N/acre, 100 lb N Meister(M)/acre, 50 lb N/acre, and 0 lb N/acre were stripapplied with a fertilizer buggy just prior to squaring. Urea and Meister N were fertilizer sources.

The test was expanded in 1998 to include N rates of 0, 25, 50, 75, 100, and 125 lb N/acre. The test design was a randomized complete block. N treatments (urea) were applied as the crop reached the two true-leaf stage.

The measurements taken on the UNR cotton included seedcotton yield, plant height, plant population, boll load, and boll weight. All data were analyzed using the Statistical Analysis System (SAS). F-tests and least significant differences (LSD) were calculated at the α=0.05 level of probability.

RESULTS

Pilot Study - 1997

UNR cotton fertilized with either 50 or 100 lb N/acre, regardless of N source, did not differ in yield (Table 1). Cotton receiving no N fertilizer had significantly lower yields than cotton that received N fertilizer. The tallest plants were found in plots receiving 100 and 50 lb N/acre. The unfertilized cotton was shortest while that receiving 100 lb Meister-N/acre was intermediate in height. Although plant populations were found to differ by as much as 32,000 plants/acre, no significant differences resulted as a function of N treatment. Boll load and boll weight were both greatest but not significantly different for the fertilized UNR cotton and lowest for the untreated cotton.

N-Rates Study

The results of the first year of the study correlated with the results of the pilot study. The N fertilization rate producing maximum yield was 50 lb N/acre (Table 2). Although a trend of higher yield was observed with greater N rates, the differences were not significantly different from the 50-lb N/acre treatment. Plant height increased with increasing N fertilization up to 100 lb N/acre. No significant differences in plant population were found as a function of N treatment. Boll load and boll weight were found to follow similar trends in response to N fertilization as lint yield. The 50-lb N/acre treatment maximized boll load and boll weight. Additional N did not significantly increase either boll load or boll weight.

PRACTICAL APPLICATION

These preliminary results indicate that UNR cotton requires less N fertilization than conventionally spaced rows for maximum yield. Yields did not increase with N rates above 50 lb N/acre in two different studies. Additionally, the 50-lb N/acre treatment was found to maximize both the boll load and boll weight. The parameters measured in this study indicate that the growth and management of UNR cotton may be substantially different from conventionally grown cotton.

Table 1. Seedcotton yield, plant height, plant population, boll load, and boll weight of cotton growth in ultra-narrow rows with 0, 50, and 100 lb N/acre and with 100 lb N(M)/acre at the Southeast Branch Experiment Station near Rohwer in 1997.

N-Rate[z]	Seedcotton Yield	Plant Height	Plant Population	Boll Load	Boll Weight
lb N/acre	lb/acre	inches	plt/acre	boll/acre	g/boll
100(M)	2,938	24.9	115,360	393,675	3.36
100	3,008	31.3	140,368	392,869	3.44
50	3,333	29.9	108,099	416,263	3.58
0	1,529	20.4	118,587	242,820	2.87
$LSD_{(0.05)}$	1,099	6.1	NS	119,875	0.38

[z] Urea as source except for Meister (M) nitrogen.

Table 2. Lint yield, plant height, plant population, boll load, and boll weight of cotton growth in ultra-narrow rows with 0, 25, 50, 75, 100, and 125 lb N/acre at the Southeast Branch Experiment Station near Rohwer in 1998.

N-Rate (urea)	Lint Yield	Plant Height	Plant Population	Boll Load	Boll Weight
lb N/acre	lb/acre	inches	plt/acre	boll/acre	g/boll
125	1,060	27.5	153,074	349,710	3.31
100	1,033	30.5	168,199	327,928	3.39
75	1,034	26.3	160,334	341,844	3.30
50	899	24.4	175,460	321,273	3.12
25	745	20.4	177,275	278,921	2.93
0	468	19.9	171,225	191,769	2.84
$LSD_{(0.05)}$	153	4.2	NS	48,066	0.28

LONG-TERM IRRIGATION METHODS AND NITROGEN FERTILIZATION RATES IN COTTON PRODUCTION: THE LAST FIVE YEARS

J.S. McConnell, W.H. Baker, and R.C. Kirst, Jr.

RESEARCH PROBLEM

Management of nitrogen (N) and irrigation are two very important aspects of cotton (*Gossypium hirsutum* L.) production. The interactions of N fertilizer and irrigation are not well documented under the humid production conditions of southeastern Arkansas (McConnell et al., 1988).

The objective of these studies was to evaluate the development and yield of intensively managed cotton soil treated with soil applied N fertilizer under several irrigation methods.

BACKGROUND INFORMATION

Over- and under-fertilization may result in delayed maturity and reduced yield, respectively (Maples and Keogh, 1971). Adequate soil moisture is also necessary for cotton to achieve optimum yields. If the soil becomes either too wet or too dry, cotton plants will undergo stress and begin to shed fruit (Guinn et al., 1981).

RESEARCH DESCRIPTION

This study was conducted at the Southeast Branch Experiment Station on an Hebert silt loam soil. The experimental design was a split block with irrigation methods as the main blocks. Nitrogen rates were tested within each irrigation method. Five irrigation methods were used from 1988 to 1993 (Table 1), but only three in 1994. Six different N rates (0, 30, 60, 90, 120, and 150 lb N/acre) with urea as the N source were tested with different application timings used for the higher (90 to 150 lb N/acre) N rates.

RESULTS

During the last five years, irrigation generally increased cotton yields except during a season when early season rainfall resulted in standing water that delayed the irrigated plants; or when verticillium wilt was prevalent (1994) (Table 2). The method of irrigation to maximize lint yield varied year-to-year, and therefore, appeared to be less important than irrigation usage, most years.

Generally, lint yield was found to increase with increasing N rates (Table 3). The N treatments that usually resulted in the greatest lint yields were applications of 60 to 150 lb N/acre, depending upon the irrigation treatment and year. Exceptions were found for the 150-lb N/acre treatment (75 lb N/acre preplant and 75 lb N/acre at first square) which was found to decrease lint yield in some irrigation blocks, and the High Frequency Center Pivot block in 1992 and 1994. The yields of the High Frequency block during those years were significantly influenced by verticillium wilt. The disease was more virulent in the plots receiving higher N rates, thereby reducing yields with increasing N.

PRACTICAL APPLICATIONS

Irrigated cotton was generally found to be higher yielding than cotton grown under dryland conditions unless verticillium wilt affected the crop. Fertilizer nitrogen requirements of cotton for maximum yield tended to be greater under irrigated production conditions compared to dryland production conditions. Fertilizer nitrogen requirements of cotton for maximum yield tended to be greater for furrow-irrigated cotton than for center pivot-irrigated cotton.

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ACKNOWLEDGMENTS

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Table 1. Duration, tensiometer thresholds and depths, and water application rates for five irrigation methods.

Irrigation method	Duration	Tensiometer Threshold	Tensiometer Depth	Water Applied
		---- cbar ----	--- inches ---	--- inches ---
High Frequency	Planting to P.B.[z]	35	6	0.75
Center Pivot	P.B. to Aug. 15	35	6	1.00
Mod. Frequency Center Pivot	Planting to Aug. 15	55	6	1.00
Low Frequency	First Irrigation	55	12	1.00
Center Pivot	Until Aug. 15	55	6	1.50
Furrow Flow	Until Aug. 15	55	12	Not Precise
Dryland	Not Irrigated	----	----	----

[z] P.B. = Peak Bloom

Table 3. Lint yield response of cotton to 10 nitrogen (N) fertilization rates and splits under five irrigation methods from 1993 to 1997.

N Rate							
PP[z]	FS	FF	LF[y]	MF	HF	FI	DL
--- lb N/acre ---			--- lb lint/acre ---				
1993							
75	75	0	1179 a	1262 cd	1152 a-c	1324 a-c	1095 bc
50	50	50	1164 a	1267 bc	1181 a-c	1345 ab	1144 a-c
30	60	60	1156 a	1269 cd	1097 c	1391 a	1191 ab
60	60	0	1171 a	1394 a-c	1156 a-c	1347 ab	1073 b-d
40	40	40	1177 a	1465 ab	1126 bc	1339 ab	1271 a
45	45	0	1150 a	1525 a	1245 a	1248 bc	1139 a-c
30	30	30	1146 a	1429 ab	1212 ab	1377 ab	1104 bc
30	30	0	1092 a	1346 bc	1121 bc	1198 c	1032 cd
15	15	0	1032 b	1255 cd	992 d	1027 d	949 d
0	0	0	863 c	185 d	833 e	784 e	966 c
LSD $_{(0.05)}$			98	143	103	136	114
1994							
75	75	0	——	——	1264 c	1600 a-c	1328 a-c
50	50	50	——	——	1256 c	1643 ab	1513 ab
30	60	60	——	——	1283 c	1633 ab	1501 ab
60	60	0	——	——	1312 bc	1602 a-c	1643 a
40	40	40	——	——	1467 a	1695 a	1559 a
45	45	0	——	——	1441 ab	1492 c	1359 a-c
30	30	30	——	——	1384 a-c	1549 bc	1381 a-c
30	30	0	——	——	1515 a	1482 c	1226 b-d
15	15	0	——	——	1313 bc	1215 d	1085 cd
0	0	0	——	——	1073 e	873 e	931 d
LSD $_{(0.05)}$			——	——	132	137	322

continued

Table 3. Continued.

	N Rate										
	PP[z]	FS	FF	LF[y]	MF	HF		FI		DL	
	--------- lb N/acre	----------		---------------------------- lb lint/acre ------------------------------							
1995											
	75	75	0	——	——	1127	a	1393	a	954	a-c
	50	50	50	——	——	1166	a	1373	ab	1039	a
	30	60	60	——	——	1193	a	1369	ab	971	ab
	60	60	0	——	——	1162	a	1376	ab	879	b-d
	40	40	40	——	——	1213	a	1360	ab	1032	a
	45	45	0	——	——	1107	a	1236	bc	946	a-c
	30	30	30	——	——	1149	a	1280	ab	947	a-c
	30	30	0	——	——	1198	a	1098	cd	852	cd
	15	15	0	——	——	964	b	980	d	781	d
	0	0	0	——	——	838	c	704	e	532	e
LSD $_{(0.05)}$				——	——	106		146		114	
1996											
	75	75	0	——	——	1315	c	1630	a	1067	a
	50	50	50	——	——	1411	a-c	1543	a	1116	a
	30	60	60	——	——	1331	bc	1572	a	1078	a
	60	60	0	——	——	1383	a-c	1522	a	1035	a
	40	40	40	——	——	1431	ab	1576	a	1174	a
	45	45	0	——	——	1382	a-c	1495	a	1050	a
	30	30	30	——	——	1440	ab	1527	a	1059	a
	30	30	0	——	——	1461	a	1633	a	1059	a
	15	15	0	——	——	1309	c	1167	d	1048	a
	0	0	0	——	——	979	d	868	c	752	b
LSD $_{(0.05)}$				——	——	114		251		155	
1997											
	75	75	0	——	——	1491	a	1739	a	1682	ab
	50	50	50	——	——	1491	a	1679	a	1777	ab
	30	60	60	——	——	1384	a	1576	ab	1867	a
	60	60	0	——	——	1528	a	1547	a-c	1629	b
	40	40	40	——	——	1491	a	1751	a	1799	ab
	45	45	0	——	——	1507	a	1582	ab	1615	b
	30	30	30	——	——	1420	a	1368	c	1754	ab
	30	30	0	——	——	1477	a	1457	bc	1338	c
	15	15	0	——	——	1157	a	1102	d	1067	d
	0	0	0	——	——	1086	b	764	e	683	e
LSD $_{(0.05)}$				——	——	159	b	207		217	

[z] Pre-plant (PP), first square (FS) and first flower (FF).

[y] Low frequency (LF), moderate frequency (MF), high frequency (HF), furrow irrigated (FI), dryland (DL).

FOLIAR NITROGEN FERTILIZATION OF COTTON IN SOUTHEASTERN ARKANSAS

J.S. McConnell, W.H. Baker, B.S. Frizzell, and C.S. Snyder

RESEARCH PROBLEM

Early-season, soil-applied nitrogen (N) fertilizer may not meet the full season N needs of a developing cotton (*Gossypium hirsutum* L.) crop. Early work indicated that supplemental N, either soil or foliar applied, may help meet crop N needs and increase yields (Maples and Baker, 1993). The objective of these studies is to determine when an increase in yield may be realized from foliar N applications to cotton.

BACKGROUND INFORMATION

Foliar fertilization of cotton with 23% N (urea) solutions with the Cotton Nutrient Monitoring Program (CNMP) is an accepted practice among Arkansas producers to meet late-season N requirements (Snyder, 1991). Recent research indicates that the response of cotton to foliar N may not be as dramatic as observed in earlier work (Parker et al., 1993).

RESEARCH DESCRIPTION

A long-term study of soil applied N fertilization and irrigation of cotton is being utilized to determine the impact of foliar N fertilization. Soil-applied N rates range from 0 to 150 lb N/acre in 30-lb N/acre increments. Three foliar N treatments (23% N [urea] solution) were applied at rates of 10 lb N/acre/treatment in 10 gal water/acre. First applications of the foliar treatments were made when the cotton reached first flower. Second and third applications were made two and four weeks after the initial application, respectively.

RESULTS

Irrigated cotton responded to foliar fertilization treatments with increased yield when soil N was restricted to pre-plant and first square application totaling 120 lb N/acre or less in 1993 (Table 1). Although the foliar fertilizer N x soil fertilizer N interaction was not significant for yield in 1994, 1995, or 1996, the foliar fertilizer N treatments significantly increased yields (Tables 2, 3, and 4). Trends in the 1994 through 1996 results were similar to those observed in 1993. The 1997 irrigated crop was delayed in maturity due to early season flooding. Interactions between soil-applied and foliar-applied N treatments did not significantly affect lint yield, although both main effects did significantly influence yield (Table 5). Trends in lint yield response were similar to the first four years of study.

Dryland cotton responded to foliar fertilization treatments with increased yield when soil N rates were low (0 and 30 lb N/acre) in 1993 and 1995 (Tables 1, 3, and 4). Soil-applied N rates of 90, 120 and 150 lb N/acre did not significantly increase cotton yields compared to 60 lb N/acre. Dryland cotton did not significantly respond to either foliar N treatments or the foliar fertilizer N x soil fertilizer N interaction in 1994 (Table 2). The 1997 dryland crop produced yields. Interactions between soil-applied N and foliar-applied N treatments did not significantly affect lint yield, although both main effects did significantly influence yield (Table 5). Trends in lint yield response were similar to the first four years of study.

Primary differences in petiole NO_3-N concentrations were due to the soil-applied N fertilizer (Table 6). Foliar treatments tended to have little effect on petiole NO_3-N levels in cotton fertilized with any rate of soil applied N.

PRACTICAL APPLICATIONS

Results indicate that foliar fertilizer N applications may increase cotton lint yield when soil-applied fertilizer N is low. Yield trends indicate that foliar fertilization of cotton that received the optimum rate or more of soil-applied fertilizer N was found to have little effect on lint yield. Petiole NO_3-N concentations were primarily dependent on soil-applied fertilizer N. Foliar fertilizer N treatments were found to not have significant, consistent positive effect on petiole NO_3-N concentration.

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ACKNOWLEDGMENTS

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Table 1. Lint yield response of cotton grown with soil-applied nitrogen (N) fertilization rates under two irrigation methods with foliar 30 lb N/acre (Fol) and 0 lb N/acre (Untrt) in 1993.

Soil N-Rate			Irrigated			Dryland		
PP^{z}	FS	FF	Fol	Untrt	Mean	Fol	Untrt	Mean
--------- lb N/acre -----			------------------------- lb lint/acre -----------------------------					
75	75	0	1321	1326	1324	1006	1095	1051
50	50	50	1249	1345	1292	1032	1143	1088
30	60	60	1316	1391	1358	1066	1191	1122
60	60	0	1419	1347	1383	957	1073	1022
40	40	40	1324	1339	1331	1088	1271	1179
45	45	0	1410	1247	1320	990	1138	1065
30	30	30	1379	1377	1378	1012	1104	1058
30	30	0	1335	1198	1267	930	1032	987
15	15	0	1117	1027	1067	1007	949	978
0	0	0	912	784	855	835	693	764
$\text{LSD}_{(0.05)}^{y}$				216			204	
$\text{LSD}_{(0.05)}^{x}$				351			334	

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

[y] $\text{LSD}_{(0.05)}$ for comparing two soil applied fertilization means within the same foliar fertilization (either Foliar or Untreated) in the same irrigation.

[x] $\text{LSD}_{(0.05)}$ for comparing two soil applied fertilization means in different foliar fertilization in the same irrigation.

Table 2. Lint yield response of cotton grown with 10 soil-applied nitrogen (N) fertilization rates and splits under two irrigation methods with foliar 30 lb N/acre (Fol) and 0 lb N/acre (Untrt) in 1994.

Soil N-Rate			Irrigated			Dryland		
PP^{z}	FS	FF	Fol^{y}	Untrt	Mean	Fol	Untrt	Mean
------------ lb N/acre---------			----------------------- lb lint/acre -------------------------					
75	75	0	1765	1643	1704	1423	1513	1468
50	50	50	1598	1632	1616	1640	1501	1481
30	60	60	1684	1698	1691	1519	1559	1539
60	60	0	1666	1549	1608	1424	1381	1403
40	40	40	1633	1618	1626	1417	1328	1372
45	45	0	1630	1602	1616	1310	1330	1320
30	30	30	1618	1492	1555	1349	1359	1354
30	30	0	1575	1482	1529	1344	1226	1275
15	15	0	1413	1215	1314	1219	1085	1152
0	0	0	1085	873	979	908	833	870
$\text{LSD}_{(0.05)}$				95			128	
Mean			1567	1481		1337	1312	
$\text{LSD}_{(0.05)}^{x}$			351			NS		

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

[y] No significant soil N x foliar N interactions were observed.

[x] $\text{LSD}_{(0.05)}$ for comparing foliar applied fertilization treatment means.

Table 3. Lint yield response of cotton grown with 10 soil-applied nitrogen (N) fertilization rates and splits under two irrigation methods with foliar 30 lb N/acre (Fol) and 0 lb N/acre (Untrt) in 1995.

Soil N-Rate			Irrigated			Dryland		
PP[z]	FS	FF	Fol[y]	Untrt	Mean	Fol	Untrt	Mean
lb N/acre			lb lint/acre					
75	75	0	1425	1393	1409	862	954	908
50	50	50	1322	1373	1348	918	1039	979
30	60	60	1434	1368	1401	859	971	915
60	60	0	1420	1376	1398	835	879	857
40	40	40	1425	1360	1393	889	1032	969
45	45	0	1230	1236	1233	895	945	920
30	30	30	1329	1280	1305	890	947	919
30	30	0	1208	1097	1153	887	852	870
15	15	0	1114	980	1047	823	781	802
0	0	0	852	704	778	695	523	609
$\mathrm{LSD}_{(0.05)}$[x]					127			
$\mathrm{LSD}_{(0.05)}$[w]						240		
$\mathrm{LSD}_{(0.05)}$[v]						193		
Mean			1276	1217		856	892	
$\mathrm{LSD}_{(0.05)}$[u]			28					

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

[y] No significant soil N x foliar N interactions were observed.

[x] LSD for comparing soil N treatment means in the irrigated test.

[w] LSD for comparing foliar N means in the same soil N treatment in the dryland test.

[v] LSD for comparing foliar N means in different soil N treatments in the dryland test.

[u] LSD for comparing foliar fertilization means in the irrigated test.

Table 4. Lint yield response of cotton grown with 10 soil-applied nitrogen (N) fertilization rates and splits under two irrigation methods with foliar 30 lb N/acre (Fol) and 0 lb N/acre (Untrt) in 1996.

Soil N-Rate			Irrigated			Dryland		
PP[z]	FS	FF	Fol[y]	Untrt	Mean	Fol	Untrt	Mean
lb N/acre			lb lint/acre					
75	75	0	1604	1630	1617	1043	1067	1055
50	50	50	1517	1543	1530	939	1116	1027
30	60	60	1660	1578	1619	1013	1078	1045
60	60	0	1671	1522	1597	1010	1035	1021
40	40	40	1675	1589	1627	1090	1164	1127
45	45	0	1610	1495	1552	1105	1050	1078
30	30	30	1615	1527	1571	1047	1126	1086
30	30	0	1575	1652	1613	1103	1059	1081
15	15	0	1416	1167	1291	1107	1048	1074
0	0	0	1102	868	998	843	752	802
LSD $_{(0.05)}$[x]					164			
LSD $_{(0.05)}$[w]						214		
LSD $_{(0.05)}$[v]						447		
Mean			1542	1469		1028	1056	
LSD $_{(0.05)}$[u]			55					

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

[y] No significant soil N x foliar N interactions were observed.

[x] LSD for comparing soil N treatment means in the irrigated test.

[w] LSD for comparing foliar N means in the same soil N treatment in the dryland test.

[v] LSD for comparing foliar N means in different soil N treatments in the dryland test.

[u] LSD for comparing foliar fertilization means in the irrigated test.

Table 5. Lint yield response of cotton grown with 10 soil-applied nitrogen (N) fertilization rates and splits under two irrigation methods with foliar 30 lb N/acre (Fol) and 0 lb N/acre (Untrt) in 1997.

Soil N-Rate			Irrigated			Dryland		
PP[z]	FS	FF	Fol[y]	Untrt	Mean	Fol	Untrt	Mean
------- lb N/acre -------			------------------------- lb lint/acre ---------------------------					
75	75	0	1752	1739	1746	1730	1681	1706
50	50	50	1591	1679	1636	1793	1777	1785
30	60	60	1801	1576	1689	1811	1867	1839
60	60	0	1757	1553	1655	1705	1629	1667
40	40	40	1714	1751	1733	1797	1799	1798
45	45	0	1629	1590	1609	1726	1614	1670
30	30	30	1529	1368	1480	1807	1754	1781
30	30	0	1538	1457	1498	1587	1338	1462
15	15	0	1324	1102	1213	1215	1067	1141
0	0	0	933	764	849	851	683	767
LSD $_{(0.05)}$[x]					187			173
Mean			1276	1217		856	892	
LSD $_{(0.05)}$[w]			28			47		

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

[y] No significant soil N x foliar N interactions were observed.

[x] LSD for comparing soil N treatment means.

[w] LSD for comparing foliar fertilization means in the irrigated test.

Table 6. Selected petiole NO_3-N responses of irrigated cotton grown with three soil-applied nitrogen (N) fertilization rates with an additional foliar 30 lb N/acre (Fol N) from 1993 to 1997.

Soil N-Rate				Sample Period						
PP[z]	FS	FF	Fol N	1	2	3	4	5	6	7
------------- lb N/acre----------				---------------------------------- ppm NO_3-N-------------------------						
1993										
50	50	50	Yes	18,765	6,771	10,100	7,074	12,242	6,771	949
50	50	50	No	19,339	5,898	10,378	4,175	10,663	5,898	1,039
45	45	0	Yes	14,652	5,281	6,789	3,009	2,211	5,281	581
45	45	0	No	11,747	5,480	7,210	1,190	516	5,480	578
0	0	0	Yes	3,440	968	1,440	410	348	968	287
0	0	0	No	8,491	2,014	1,546	2,055	4,455	2,014	287
1994										
50	50	50	Yes	10,166	10,715	11,072	13,901	8,104	2,912	393
50	50	50	No	7,378	8,231	7,978	13,201	8,116	3,201	300
45	45	0	Yes	4,639	6,193	3,643	1,460	227	101	268
45	45	0	No	3,768	5,266	2,564	478	63	106	204
0	0	0	Yes	148	50	236	108	58	123	249
0	0	0	No	335	59	285	154	58	106	291
1995										
50	50	50	Yes	11,190	13,720	7,453	11,374	4,338	2,399	674
50	50	50	No	15,071	13,024	5,657	7,639	4,220	552	161
45	45	0	Yes	11,201	7,848	1,380	522	321	122	66
45	45	0	No	-------	8,109	810	500	565	16	20
0	0	0	Yes	1,321	1,159	447	20	591	64	20
0	0	0	No	879	3,364	14	20	96	9	14
1996										
50	50	50	Yes	10,744	11,443	8,631	8,421	7,816	4,425	1,913
50	50	50	No	10,341	9,631	4,727	6,546	4,544	2,268	459
45	45	0	Yes	9,816	9,639	4,062	1,243	671	314	66
45	45	0	No	9,090	7,506	1,821	878	571	68	155
0	0	0	Yes	207	258	371	359	168	21	66
0	0	0	No	975	256	268	304	168	21	13
1997										
50	50	50	Yes	7,798	10,290	3,769	3,229	1,834	541	51
50	50	50	No	6,191	6,393	3,430	1,042	756	201	83
45	45	0	Yes	4,886	1,012	465	360	150	201	6
45	45	0	No	6,684	1,283	401	197	150	16	17
0	0	0	Yes	329	1	61	352	150	197	61
0	0	0	No	560	1	61	105	197	61	108

[z] Pre-plant (PP), First Square (FS) and First Flower (FF).

TIMING OF EARLY SEASON NITROGEN FERTILIZATION OF COTTON

J.S. McConnell and W.H. Baker

RESEARCH PROBLEM

The recommended timing of early-season nitrogen (N) fertilizer to meet the needs of a developing cotton (*Gossypium hirsutum* L.) crop has not been well established (Bonner, 1995). Recommended N rates vary with soil test results, field history, and the development of the crop. The objective of these studies is to determine when is the optimum time for early season N applications to cotton.

BACKGROUND INFORMATION

Arkansas cotton producers have traditionally met early-season N requirements of the crop with a pre-plant N application. The first soil application of nitrogen fertilizer to cotton is sometimes delayed until stand establishment due to inclement weather or seedling disease pressure (Minter Applebury, personal communication). It is speculated that delaying the first N application might result in early season N deficiency and possible yield loss.

RESEARCH DESCRIPTION

A study of early-season, soil-applied N fertilization and irrigation of cotton is being utilized to determine the impact of delaying N fertilization. Five soil-applied fertilizer N splits of 100 lb N/acre and a 0 lb N/acre control are being tested. The experiment is duplicated under both furrow-irrigated and dryland conditions. First N applications are made approximately two to four weeks pre-plant. Second applications were made after the crop emerged (two to four true leaves). The third application was made when the crop reached first square.

RESULTS

Yields were slightly higher under irrigated conditions than under dryland in 1995 but were much greater in 1996. This trend was reversed in 1997 due to standing water in the irrigated block. Although yields were very high in 1997, greatest yields were found in the dryland block (data not shown).

Trends in the response to the N treatments were similar in the irrigated and dryland blocks in 1995, in the irrigated block in 1996, and in both blocks again in 1997 (Table 1). Treatments did not significantly affect yields in dryland cotton in 1996. The unfertilized control was the lowest yielding treatment. The 100 lb N/acre pre-plant treatment was the next lowest yielding and not significantly different from the unfertilized control in 1995. The other four treatments did not significantly differ in yield.

A trend of higher yield was observed with treatments that included a first square N application. This trend is consistent with low yield increases from the 100 lb N/acre pre-plant treatments. A possible explanation for the ineffectiveness of the pre-plant treatments are spring weather conditions. Rainy, wet weather probably increased the likelihood of denitrification and leaching of nitrate. These two processes, denitrification and leaching, remove N from the soil thus reducing plant uptake and may have caused the pre-plant treatments to be less effective than N-fertilizer applied later in the growing season.

PRACTICAL APPLICATIONS

Preliminary results indicate that early season N applications shortly after emergence and at first square were more effective in meeting the N nutritional needs of cotton than pre-plant N applications. Because these are preliminary results, research should be continued before final conclusions are drawn.

LITERATURE CITED

Bonner, C.M. 1995. 1995 Cotton production recommendations. University of Arkansas Cooperative Extension Service, AG422-4-95.

ACKNOWLEDGMENTS

Support for this research was provided by the Arkansas Fertilizer Tonnage Fee.

Table 1. Lint yield response of cotton grown with early-season soil-applied nitrogen (N) treatments under furrow irrigation and dryland conditions in 1995 and 1996.

Soil N-Rate			1995		1996		1997	
PP[z]	AE	FS	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland
---------- lb N/acre -----			----------------------------------- lb lint/acre -----------------------------					
0	50	50	1068	909	1747	1308	1699	2011
50	0	50	990	877	1721	1263	1634	1967
0	0	100	1086	915	1602	1293	1565	1947
0	100	0	1020	869	1475	1203	1524	1958
100	0	0	714	718	1267	1336	1379	1811
0	0	0	707	681	983	1069	952	1153
LSD $_{(0.05)}$			158	145	173	NS	261	173

[z] Pre-plant (PP), After Emergence (AE), First Square (FS).

RICE AND SOYBEAN RESPONSE TO PHOSPHORUS FERTILIZATION

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C.E. Wilson, Jr., R.J. Norman, and D. Frizzell

RESEARCH PROBLEM

Phosphorus (P) fertilizer is commonly recommended on many Arkansas soils when soybean is grown. Current recommendations are to apply 0-40-0 to rice when soil test P is < 25 lb P / acre. For irrigated soybean grown on silt loam soils the recommendation is to apply 0-45-0 when soil test P is < 45 lb P / acre.

BACKGROUND INFORMATION

Previous studies investigating rice response to P fertilization have documented that rice response to P fertilization usually occurs on alkaline silt loam soils when grown in rotation with soybean. However, it has been observed that rice following rice in rotation may respond to P fertilization on both alkaline and acid silt loam soils. This research was initiated in preparation of evaluating rice response to previous crop effect and P fertilization practices. In 1999, rice will follow both rice and soybean in rotation to examine the effect of previous crop on P nutrition of rice.

RESEARCH DESCRIPTION

For purposes of this study, soybean ('Hutcheson') and rice ('Drew') were seeded at the Rice Research and Extension Center (RREC) and Pine Tree Branch Experiment Station (PTBES) during the spring of 1998. These sites were chosen since both are silt loam soils and have different soil pH (Table 1). Phosphorus rates of 0, 20, 40, 80, and 120 lb P_2O_5 / acre were applied to the soil surface immediately before seeding. Rice and soybean plots at PTBES were fertilized with 10 lb Zn / acre in the form of zinc sulfate as recommended for <6.5 pH. Rice was drill seeded with 7-inch row spacing at each location. Soybean was drill seeded at PTBES and seeded in 30-inch rows at the RREC in plots measuring 10 ft by 20 ft. For soybean, whole plant and leaf samples were harvested at the R3 growth stage. Rice tissue samples were harvested at panicle initiation. Tissue was digested and analyzed for P concentration. Grain yield was measured at physiological maturity. Data from each location and crop were analyzed separately as a randomized complete block design with four replications.

RESEARCH RESULTS

Application of P did not significantly increase or decrease rice and soybean yields at either location (Table 2). The extremely low rice yields at PTBES and soybean yields at RREC indicate that a factor other than P limited yield in 1998. Soybean emergence and subsequent growth was erratic at the RREC due to hot and dry weather conditions after seeding and emergence. Rice yields at PTBES have historically been below average due presumably to alkaline or saline soil conditions. Additionally previous phosphorus, potassium, and zinc fertility research has failed to document rice yield increases at this location. Only soil acidification has provided significant rice yield increases at PTBES. In general, soybean whole plant tissue and top leaf tissue at PTBES and RREC, respectively, increased with increasing P fertilizer rate. Elemental analysis of rice tissue is not yet complete.

PRACTICAL CONSIDERATIONS

Based on current soil test guidelines, P would have been recommended for application to rice and soybean at the RREC but not PTBES. Yield responses were not found at either location for either crop. Additional research is required to gain a better understanding of soybean and rice response to P fertilization on different soils and soil test levels. The abnormal environmental conditions experienced during 1998 also suggest that caution be used in drawing conclusions from this single year of data. For the 1999 cropping season new phosphorus fertilization recommendations for rice will be implemented. Recommendations will include both soil test P and soil pH levels for specific P application rates (Table 4).

ACKNOWLEDGMENT

Financial support for this research was provided from rice grower check-off funds administered through the Arkansas Rice Research and Promotion Board.

Table 1. Soil chemical properties of 1998 research studies conducted at the Rice Research and Extension Center (RREC) and Pine Tree Branch Experiment Station (PTBES) evaluating rice and soybean response to phosphorus fertilization.

	Soil Test Level	
Soil Test Parameter	PTBES	RREC Study
pH[z]	7.5	6.0
EC, umhos/cm[z]	156	114
P, lb/A	42	20
K, lb/A	172	255
Ca, lb/A	3555	2225
Mg, lb/A	672	272
Zn, lb/A	2.1	1.1

[z] pH and EC measurements are for a 1:2 soil wt: water volume ratio.

Table 2. Rice and soybean yield response to phosphorus fertilization in 1998 studies conducted at the Rice Research and Extension Center (RREC) and Pine Tree Branch Experiment Station (PTBES).

Phosphorus	Soybean Yield		Rice Yield	
Fertilizer Rate	RREC	PTBES	RREC	PTBES
lb P_2O_5/acre	-------------------------------------- bu/acre--------------------------------------			
0	23	38	139	102
20	21	39	139	105
40	19	41	137	99
80	23	40	139	105
120	17	41	139	107
P-value	0.41	0.87	0.99	0.92
LSD(0.05)	NS[z]	NS	NS	NS
C.V., %	40.2	16.6	8.4	9.7

[z] NS = not significant.

Table 3. Soybean whole plant and top leaf phosphorus concentration response to phosphorus fertilization in 1998 studies conducted at the Rice Research and Extension Center (RREC) and Pine Tree Branch Experiment Station (PTBES).

	Soybean Tissue P Concentration			
Phosphorus	RREC		PTBES	
Fertilizer Rate	Whole Plant	Top Leaves	Whole Plant	Top Leaves
lb P_2O_5/acre	-- % P -------------------------------------			
0	0.18	0.21	0.32	0.29
20	0.19	0.22	0.37	0.29
40	0.18	0.21	0.40	0.30
80	0.21	0.22	0.37	0.30
120	0.20	0.22	0.39	0.31
P-value	0.07	0.93	0.91	0.07
$LSD_{(0.05)}$	0.03	NS[z]	NS	0.02
C.V., %	17.3	14.7	68.3	5.6

[Z] NS = not significant

Table 4. Phosphorus fertilizer recommendations for rice, 1999.

	Soil Test P		
Soil pH	< 30 lbs P/A	31 - 50	> 50
	------------------------- lb P_2O_5/acre-------------------------		
<6.5	20	0	0
> 6.5	60	40	0

RICE RESPONSE TO PHOSPHORUS AND POTASSIUM FERTILIZATION AT DIFFERENT SOIL TEST LEVELS

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RESEARCH PROBLEM

Phosphorus (P) and potassium (K) fertilization is required for maximum production of rice (*Oryza sativa* L.) and soybean (*Glycine max* Merr.) on many Arkansas soils. In 1998, the University of Arkansas recommendations for P for rice were 40 lb P_2O_5 / acre when soil test level (Mehlich III) is <25 lb P / A. Based on recent research results, soil test recommendations for P will be modified for the 1999 growing season to include soil pH in recommendations. Potassium is recommended at a rate of 60 lb K_2O and 80 lb K_2O / acre when soil test levels are 125 to 175 and <125 lb K / acre, respectively. These studies were initiated in 1996 to evaluate the response of rice and rotation crops to P and K fertilization on a range of soil test P and K levels.

BACKGROUND INFORMATION

The recent development of precision agriculture technology has caused universities to reevaluate crop fertilization recommendations and philosophies to determine the utility of this technology for production agriculture. Recent research on rice response to K fertilization suggests that rice yield increases to K fertilization occur only when soil test K levels are extremely low (<100 lb K / acre) and that University of Arkansas K fertilization recommendations are sufficient for maximum economic rice yield production. However, research also shows that Mehlich III soil test P level alone is a poor predictor of rice yield response to P fertilization. Rice yield increases from P fertilization typically occur on alkaline silt loam soils or on recently leveled fields. Changes will be made to University of Arkansas P fertilizer recommendations for rice in 1999 based on these research findings. Information from studies such as this are important to verify that soil test recommendations are accurate so that growers may produce maximum yields and reduce production costs.

RESEARCH DESCRIPTION

West Study

A study was initiated with rice at the Pine Tree Branch Experiment Station (PTBES) near Colt, during the spring of 1996 (results are reported in the Arkansas Agricultural Experiment Station Research Series 455 and 459). Plots have been maintained since the initiation of this study in 1996. A rotation of rice (1996), soybean (1997), and rice (1998) has been cropped on these plots. Fertilizer applications have been based on the initial soil test results in 1996 (Table 1). Grid sampling identified six areas within the plot area that combined the categories of low, medium, or high soil test K and low or high soil test P. Phosphorus and K fertilizer was applied at either 0, 0.5, 1, or 2 times the recommended rate for each soil test level. 'LaGrue' rice was planted in plots 8 ft by 20 ft and harvested for total dry matter three weeks after 50% heading and for grain yield at maturity. The experiment was arranged as a a completely randomized factorial with five replications.

East Study

This study was initiated in 1996 at the Pine Tree Branch Experiment Station near Colt. Plots have been maintained since the initiation of this study in 1996. A rotation of soybean (1996), soybean (1997), and rice (1998) has been cropped on these plots. Information on soybean response to soil and fertilizer recommendations may be found in the Arkansas Agricultural Experiment Station Research Series 455 and 459. Treatments, sampling, cultivar, and management of plots were the same as described for the West Study.

RESULTS

West Study

The main effect of soil test P and K level, averaged across fertilizer applications rates, was found to influence panicle weights, straw weight, and grain yields of rice three weeks after 50% heading (Table 2). The high P and low K soil test level produced significantly lower grain yields and panicle weights, but significantly greater dry straw weights compared with other soil test level treatments. Fertilizer application rate did not influence grain yields, panicle weights, or straw dry weight production (Table 3). The interaction between soil test level and recommended fertilizer rate was not significant (Table 4).

East Study

The main effect of soil test P and K level significantly influenced only grain yield (Table 2). Fertilizer application rate did not influence grain yields or straw dry weights. The interaction between soil test level and recommended fertilizer rate was not significant (Table 5).

PRACTICAL CONSIDERATIONS

In the past six years research has found that rice responds to K fertilizer applications only when soil test levels are extremely low (<100 lb K/acre). Additionally, it has been observed that soil test P level, including very low soil test levels (<20 lb P/acre), is not a good predictor of rice response to P fertilization. Rice yield responses to P fertilization are most likely on alkaline soils. Based on soil chemical properties, yield responses to P and K fertilization were not expected at these two locations. Although rice did not respond to fertilizer application rate, data suggests that the soil test levels of P and K influence rice growth and yields. The relationship for rice growth and yield to extractable soil nutrients is not clear from this data. The high P and medium K soil test levels produced the highest numerical yield in both tests. Another factor, such as salinity, straighthead, or specific ion toxicities, may be the most limiting factor rice grain yield on these soils. Additionally, rice yields did not follow the same trend as found in 1996 for the West Study.

ACKNOWLEDGMENTS

Thanks to the Potash and Phosphate Institute and producers contributing to the Arkansas Fertilizer Tonnage Fees for partial support of this project.

Table 1. General soil test information from test areas when each study was initiated.

Soil Test	Soil Test Level					
	West Study			East Study		
Parameter	Average	High	Low	Average	High	Low
pH	6.0	6.4	5.2	5.2	6.7	4.1
P, lb/acre	25	40	15	34	70	16
K, lb/acre	183	269	132	173	318	115
Ca, lb/acre	2254	2871	1756	2399	3522	1306
Mg, lb/acre	474	547	404	172	237	106
Zn, lb/acre	1.9	2.8	1.1	0.9	11.3	0.1

Table 2. Influence of initial soil test level (1996) on rice dry matter accumulation (panicles and straw) three weeks after 50% heading and grain yield response.

Initial Soil Test Level[z]		West Study			East Study	
		Panicle Dry Weight	Straw Dry Weight	Grain Yield	Total Dry Weight	Grain Yield
P	K	--------lb/acre--------		bu/acre	lb/acre	bu/acre
Low	Low	5,488	8,453	122	14,943	152
Low	Medium	4,602	9,157	133	15,734	146
Low	High	4,563	8,607	125	15,088	139
High	Low	3,788	11,142	108	14,761	155
High	Medium	5,510	8,385	134	15,137	159
High	High	5,418	8,618	127	14,719	147
P value		0.03	0.002	0.002	0.92	0.02
LSD $_{(0.05)}$		811	1,786	6	2,571	8
C.V.%		25.7	31.3	8.0	24.1	7.7

[z] Soil Test Level is based on the following: Low P < 25 lb P/acre; High P > 25 lb P/acre; Low K < 125 lb K/acre; Medium K 125-175 lb K/acre; and High K > 175 lb K/acre.

Table 3. Influence of recommended fertilizer application rate on rice dry matter accumulation (panicles and straw) three weeks after 50% heading and grain yield response.

	West Study			East Study	
Fertilizer Rate[z]	Panicle Dry Weight	Straw Weight	Grain Yield	Total Dry Weight	Grain Yield
	-----------lb/acre----------		bu/acre	lb/acre	bu/acre
0 x	4,858	8,640	128	15,623	147
0.5 x	4,820	8,533	121	15,313	150
1 x	5,098	9,691	125	15,295	151
2 x	4,874	9,377	125	14,024	151
P-value	0.88	0.32	0.12	0.44	0.403
LSD $_{(0.05)}$	662	1,458	5	7,203	7
C.V.%	25.7	31.3	8.0	24.1	7.7

[z] Fertilizer rate (i.e., 0, 0.5, 1, or 2) is multiplied by the rate recommended (x) by the University of Arkansas Soil Test Guidelines.

Table 4. Influence of initial 1996 soil test values and recommended fertilizer rate on rice grain yields during 1998 for the West Study.

	Grain Yield[y]					
Fertilizer	Low P (< 25 lb P/acre)			High P (> 25 lb P/acre)		
Rate[z]	Low K	Medium K	High K	Low K	Medium K	High K
0 x	121	135	129	109	140	133
0.5x	118	131	117	108	130	125
1 x	126	136	124	106	133	123
2 x	121	132	131	108	134	127

[z] x recommended fertilizer rate.

[y] Interaction for Recommended Fertilizer rate x soil test P and K level was not significant (P-value = 0.91)

Table 5. Influence of initial 1996 soil test values and recommended fertilizer rate on rice grain yields during 1998 for the East Study.

Fertilizer	Grain Yield[y]					
	Low P (< 25 lb P/acre)			High P (> 25 lb P/acre)		
Rate[z]	Low K	Medium K	High K	Low K	Medium K	High K
0 x	145	144	136	163	150	142
0.5 x	150	146	139	151	162	149
1 x	154	145	145	156	157	150
2 x	158	148	134	150	167	147

[z] x recommended fertilizer rate

[y] Interaction for Recommended Fertilizer rate x soil test P and K level was not significant (P-value = 0.65)

HIGHBUSH BLUEBERRY RESPONSE TO NITROGEN RATE AND METHOD OF APPLICATION: FIFTH-YEAR RESULTS

J.R. Clark and R.A. Allen

RESEARCH PROBLEM

Highbush blueberries are most often fertilized with dry nitrogen (N) fertilizers applied to the surface of the blueberry row. Split application of these dry materials has been recommended, usually with the total N applied in three applications. The application of fertilizer by injection in the drip irrigation system (fertigation) has become more common in blueberry plantings. Numerous fertilizer applications are made with this approach, usually 10 to 14 per season, but with smaller amounts of fertilizer applied each time as compared to the dry application method. The continuing objective of this study was to compare N rates and methods of application (fertigation and surface-applied) on highbush blueberries in Arkansas.

BACKGROUND INFORMATION

No research studies have been conducted in Arkansas that compare the response of blueberry to fertilizer application methods. Also, information is not available that compares the response of blueberries to fertilizer rates using these methods. Rates of fertilizer N on blueberry plantings in the United States usually range from 60-120 lb N/acre, with a leaf content of 1.6% considered the minimum for optimum plant performance. Higher N rates are often suggested where organic mulches such as sawdust are applied to the plants.

RESEARCH DESCRIPTION

A planting of sawdust-mulched ‘Bluecrop’ highbush blueberries was established in March 1994 at the Arkansas Agricultural Research and Extension Center in Fayetteville, on a Captina silt loam soil, and N fertility treatments were imposed on these plants in their initial year in the field. Treatments prior to 1998 included a range of N rates from 0 to 240 lb N/acre, either surface-applied or by fertigation. Ammonium sulfate was the N material used. In 1998, the same N rates were continued but urea was the N fertilizer used due to the pH in the planting being reduced to a level where a less acidifying fertilizer was warranted. The dry, surface-applications were begun in mid-April, and made again at 6 and 12 weeks later. Fertigation was begun at the time of the first dry application, and the total N was applied in 12 applications at approximately 10- to 14-day intervals with the application period extending into late July. Six replications of two-plant plots of each treatment combination were utilized, arranged in a randomized complete block design. Fruit yields and berry weights were measured in June and leaf samples were collected in early August and analyzed for elemental content. Plant vigor ratings were taken at the time of leaf sampling. Data were analyzed by SAS.

RESULTS

Method of application influenced only leaf potassium (K) and magnesium (Mg) and plant vigor rating (Tables 1 and 2). Nitrogen rate influenced leaf N and sulfur (S), berry weight, and plant vigor rating. There was a significant interaction of method and N rate only for berry weight and plant vigor. However, the differences in berry weights in the means were very small and of no practical significance. For the plant vigor ratings, higher vigor was achieved with any N rate compared to the control, regardless of how it was applied. For the fertigation ratings, higher vigor was achieved with each increase in N rate.

For the two variables influenced by method of application, leaf K and Mg, the leaf K level was higher and the Mg level lower for the surface-applied treatment (Table 1). However, these differences among leaf levels were quite small and probably of no practical significance.

Leaf N levels increased with increasing N rate for both methods of application (Table 1). However, an N rate of 180 lb/acre for either application method was required to achieve the minimum leaf level of 1.6% recommended for highbush blueberry. This differs from findings from the two previous fruiting years (1996 and 1997), in that the 1.6% foliar level was consistently attained with an N rate of 120 lb/acre in those years. The reason for this difference may be due to the change in N material used in 1998, in that in 1998 urea was used and more of the applied N may have volatilized into the atmosphere resulting in less N for plant uptake. Leaf S was higher with increased N rate but the increase was only 0.01 to 0.02% and was of no practical significance (Table 1).

PRACTICAL APPLICATION

As in previous years, our results indicate that the method of application had little practical effect on any of the variables measured. The N rate response was most important for leaf N level with increased leaf N with increased N rate, and for plant vigor rating which was usually higher for increasing N rate. For the 1998 data, an N rate of 180 lb/acre was needed to attain an adequate leaf N level of 1.6%. This differs from previous years in that 120 lb/acre N had been the N rate needed to achieve this needed leaf level. Further data will be needed to verify that this was due to the change from ammonium sulfate to urea as the N source.

Table 1. Leaf macroelement content and analysis of variance F-test significance for method of application and nitrogen (N) rate treatments to highbush blueberries, fifth-year results (1998).

Application Method	N Rate[z]	N	P	K	Ca	Mg	S
		-------------------------------- % dry wt. ---------------------------------------					
Control	0	1.27	0.06	0.36	0.83	0.23	0.10
Surface	60	1.38	0.06	0.36	0.83	0.21	0.11
Surface	120	1.56	0.06	0.43	0.67	0.18	0.12
Surface	180	1.76	0.06	0.57	0.64	0.18	0.11
Surface	240	1.81	0.05	0.50	0.65	0.16	0.12
Fertigation	60	1.35	0.06	0.38	0.75	0.20	0.10
Fertigation	120	1.44	0.06	0.37	0.77	0.22	0.11
Fertigation	180	1.60	0.06	0.38	0.81	0.21	0.11
Fertigation	240	1.93	0.05	0.39	0.69	0.20	0.12
F-test significance level (prob.>F)							
Source of variation							
Method		0.37	0.56	0.04	0.14	0.02	0.26
Rate		0.01	0.08	0.30	0.16	0.32	0.03
Method x Rate		0.34	0.95	0.35	0.13	0.42	0.52
Rate linear (surface)[y]		0.01	0.10	0.05	0.03	0.06	0.31
Rate quadratic (surface)		0.44	0.54	0.26	0.13	0.75	0.69
Rate linear (fertigation)		0.01	0.05	0.93	0.54	0.62	0.01
Rate quadratic (fertigation)		0.13	0.84	0.89	0.19	0.25	0.81

[z] Rate in total N in lb/acre, based on 1089 plants/acre.

[y] Linear and quadratic responses include data from the control (0 N rate) in the analysis.

Table 2. Yield, berry weight, plant vigor rating and foliar (leaf) microelement content and analysis of variance F-test significance for method of application and nitrogen (N) rate treatments to highbush blueberries, fifth-year results (1998).

Application Method	Plant N Rate[z]	Yield	Berry wt.	Vigor[y]	Fe	Mn	Zn	Cu
		(g/plant)	(g)	------------------	ppm dry wt.	-------------------		
Control	0	374	1.2	1.2	89	297	13.8	10.3
Surface	60	701	1.4	3.1	95	414	10.5	10.8
Surface	120	510	1.5	3.5	101	506	11.9	9.6
Surface	180	349	1.1	2.0	70	548	13.1	9.7
Surface	240	593	1.3	2.3	93	580	10.2	10.3
Fertigation	60	632	1.2	2.9	73	380	11.1	10.1
Fertigation	120	754	1.3	3.2	85	472	13.0	9.9
Fertigation	180	657	1.2	3.3	95	430	13.1	10.1
Fertigation	240	686	1.3	3.9	79	661	9.0	10.0
F-test significance level (prob.>F)								
Source of variation								
Method		0.45	0.41	0.01	0.43	0.65	0.94	0.82
Rate		0.93	0.01	0.01	0.85	0.07	0.21	0.57
Method x Rate		0.89	0.03	0.01	0.26	0.68	0.94	0.72
Rate linear (surface)[x]		0.69	0.02	0.01	0.52	0.18	0.98	0.56
Rate quadratic (surface)		0.43	0.51	0.71	0.54	0.72	0.24	0.12
Rate linear (fertigation)		0.96	0.91	0.01	0.58	0.02	0.39	0.99
Rate quadratic (fertigation)		0.86	0.55	0.48	0.26	0.38	0.09	0.86

[z] Rate of actual N in lb/acre, based on 1089 plants/acre.
[y] Plant vigor ratings of 1 to 5 with 5=high vigor.
[x] Linear and quadratic responses include the data from the control (0 N rate) in the analysis.

SOUTHERN HIGHBUSH BLUEBERRY RESPONSE TO NITROGEN RATE: SECOND-YEAR RESULTS

J.R. Clark, J.F. Young, and J.M. Phillips

RESEARCH PROBLEM

The southern highbush blueberry, a hybrid of *Vaccinium corymbosum* L. (the northern highbush blueberry) and one or more southern-adapted *Vaccinium* species, is intended to provide an early-ripening, lower-chill blueberry with the fruit quality of northern highbush with adaptation to the warmer conditions of the southern U.S. This new type of blueberry holds promise for blueberry growers in central and southern Arkansas because fruit ripening could be advanced by one to four weeks compared to the rabbiteye (*V. ashei* Reade) cultivars currently grown in these areas of the state. Research on southern highbush blueberries has been conducted previously in Arkansas in the areas of cultivar development and testing, but only limited research has been done on the cultural aspects of southern highbush production. This study continued in 1998 with the objective the determination of the appropriate nitrogen (N) rate for the southern highbush blueberry.

BACKGROUND INFORMATION

No research studies have been conducted in Arkansas that compare the response of southern highbush blueberry to varying N rates. Rates of N applied to highbush blueberry plantings in the U.S. usually range from 60-120 lb / acre, with a leaf N content of 1.6% considered the minimum for optimum plant performance. Higher N rates are often suggested where organic mulches such as pine straw or sawdust are applied to the plants. Clark et al. (1994) reported that highbush and southern highbush blueberries were similar in leaf elemental content, while the rabbiteye blueberry differed in leaf level for several elements when fertilized at similar N rates. This study, begun in 1997 and continued for 1998, focuses on southern highbush response to a range of N levels.

RESEARCH DESCRIPTION

A planting of pine straw-mulched 'Cape Fear' southern highbush blueberry was established in late winter of 1994 at the Southwest Research and Extension Center, Hope, on a silt loam soil. The plants were fertilized uniformly the first three years (1994 through 1996) with ammonium sulfate. The N rate applied to all plants in 1994 was 60 lb N/acre, and in 1995 and 1996, 90 lb N/acre was applied. Nitrogen rate treatments were begun in 1997, and urea was chosen as the N source due to the pH of the planting being less than 5.3, indicating a need to use a less acidifying N source for that year. The N rates using urea continued for 1998 including a range from 0 to 240 lb N/acre, all surface-applied within the drip line of the plants and the fertilizer placed on the mulched area under the plants. The urea applications were made at budbreak (13 March), 24 April and 5 June 1998, with one-third of the total annual N applied at each date. Five replications of two-plant plots of each N level were utilized, arranged in a randomized complete block design. Prior to fertilization, soil samples were taken from each plot to determine if any 1997 N rates influenced soil analysis values for the 1998 season. Fruit yields and berry weights were measured in May and June and foliar samples were collected in early August and analyzed for elemental content. Data were collected from one of the two plants in each plot only and the data were analyzed by SAS.

RESULTS

Soil analysis values taken in February indicated that at the higher N rates, pH, calcium (Ca), and magnesium (Mg) were usually statistically lower compared to the control or 60 lb / acre rate (Table 1). Levels of electrical conductivity (EC) and nitrate increased with increasing N rate (Table 1). Levels of sodium (Na), iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) were not impacted by N rate (data not shown). These data reflect the carryover effect of N applications from 1997. From a management standpoint, none of the soil variables were affected greatly enough to affect fertility decisions for the year. The levels of EC and nitrate were not high enough to require a reduction in fertilizer for the current, and the effect on pH was probably not substantial enough to require pH adjustment. However, trends over time for N rate impact on pH reduction should be monitored to ensure that pH does not decline below an acceptable level.

The highest yield was obtained with the 120 lb / acre treatment, although the yields for this N rate were similar to the control and 180 lb / acre rate (Table 2). It is clear from the data that N rate did not provide a consistent influence on yield for the plants in this study. Berry weights were similar among the treatments. Leaf N, potassium (K), Ca and Mg were influenced by N rate (Table 2). The highest leaf N levels were achieved with the 240 lb / acre rate, although the leaf levels for all plants where any N was applied were statistically similar. The control plants were N deficient (based on a deficiency level of 1.6%). Leaf K increased with increasing N rate. Leaf Ca and Mg were numerically highest for the control but both were statistically similar to the highest N rate.

Leaf phosphorus (P) and S were unaffected by N level (Table 2) and microelemental levels (Fe, Mn, Zn, and Cu) were mostly unaffected by N rate (data not shown).

PRACTICAL APPLICATION

These second-year results indicate several influences of N rate on both soil and plant responses on 'Cape Fear' southern highbush blueberry. Although N rate did not impact yields consistently, a number of other variables were affected that are important to blueberry growers. An awareness of how higher N rate affects soil variables, most importantly pH, EC and nitrate, is important and these variables should be monitored annually to ensure that they are within acceptable ranges. The data indicate that higher N rates have the greatest potential to influence these soil variables. Among N rate effects on leaf levels, the level of N is most noteworthy. Since levels of less than 1.6% indicate deficiency, it is clear that the addition of at least 60 lb / acre was necessary to maintain adequate leaf N levels. However, the level of 2.27% from the highest N rate is higher than commonly seen and the 240 lb / acre rate might be considered excessive based on the leaf levels resulting from this application. The commonly recommended N fertilizer rate of 120 lb / acre for mulched highbush blueberries appears to be acceptable for southern highbush based on our 1998 results.

LITERATURE CITED

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Table 1. Soil analysis values from February 1998, from a planting of five year-old 'Cape Fear' southern highbush blueberry as affected by 1997 nitrogen (N) fertilization level (using urea) at the Southwest Research and Extension Center, Hope.

N Rate	pH	EC^z	Nitrate	P	K	Ca	Mg	S
(lb / acre)			------------------------ lb / acre --------------------------------					
Control	4.8 a^y	52.8 b	7.2 b	82.6 a	100.4 a	723 a	76.2 a	34.2 a
60	4.6 ab	57.4 a	8.8 b	84.6 a	90.2 a	495 b	57.4 b	35.8 a
120	4.4 b	58.6 b	10.4 ab	80.2 a	88.2 b	466 b	53.4 b	34.8 a
180	4.4 b	64.2 ab	12.0 ab	82.4 a	90.6 ab	458 b	51.8 b	39.2 a
240	4.5 b	72.6 a	14.8 a	87.8 a	93.6 ab	586 ab	57.4 b	39.0 a

^{z} Electrical conductivity in umhos / cm.

^{y} Mean separation by LSD$_{(0.05)}$.

Table 2. Yield, berry weight, and leaf macroelemental analysis of five-year-old 'Cape Fear' southern highbush blueberry as affected by 1997 N fertilization level (using urea) at the Southwest Research and Extension Center, Hope.

N Rate	Yield[z]	Berry wt.	N	P	K	Ca	Mg	S
(lb/acre)		g	------------------------	% dry wt.	------------------------------			
Control	5008 ab[y]	1.0 a	1.48 b	0.08 a	0.30 b	0.80 a	0.25 a	0.11 a
60	4223 b	1.1 a	1.85 a	0.09 a	0.39 ab	0.71 ab	0.22 a	0.13 a
120	6099 a	1.2 a	1.85 ab	0.09 a	0.39 ab	0.65 ab	0.21 ab	0.12 a
180	5234 ab	1.1 a	1.91 ab	0.08 a	0.46 a	0.56 a	0.18 b	0.11 a
240	4106 b	1.0 a	2.27 a	0.09 a	0.47 a	0.66 a	0.22 a	0.13 a

[z] Yield in lb/acre based on a plant density of 1089 plants/acre.

[y] Mean separation by $LSD_{(0.05)}$.

ADAPTATION OF SOYBEAN CULTIVARS TO RESTRICTIVE SOIL ENVIRONMENTS

J.D. Widick and R.G. Harrell

RESEARCH PROBLEM

Many soybean cultivars available to producers in Arkansas are capable of producing yields of 60 bu / acre or more when grown in high-yield environments. However, some Arkansas soybean growers have reported decreasing yield trends over the past 10-15 years in specific fields. Although the newest, most productive cultivars have been planted, and recommended fertilization and cultural practices have been followed, yields on these fields are lower than a decade ago. This research is being conducted to identify the most productive cultivars for these specific environments and to develop new improved cultivars that are better adapted to restrictive environments.

BACKGROUND INFORMATION

Most breeding programs evaluate yield potential of experimental strains in environments which supply nutrients and water in quantities to maximize seed production. Evaluations are conducted in the presence of identified problems, such as specific diseases, when strains carry genetic resistance or tolerance for the known problem. Evaluations are normally not conducted in environments where unidentified problems exist.

RESEARCH DESCRIPTION

Four sites were selected in 1998 based on farmer and extension agent reports of lower yields in recent years than previously obtained on these sites. Sites selected were in Craighead, Cross, and Monroe Counties. Site descriptions for two locations are presented in Table 1. One hundred sixty-three genotypes consisting of current cultivars, plant introductions, and experimental strains were grown to identify productive genotypes for each site. Notes on agronomic traits and seed yield were recorded. Leaf samples were collected from each plot at early pod-fill. To determine whether soil compaction might be a factor in yield reduction at Monroe, a split-plot test was conducted in which main plots were either subsoiled or not subsoiled. Four varieties were planted as subplots. Appropriate main plots were subsoiled, before planting, to a depth of 14 to 18 inches with tines spaced 20 inches apart.

RESULTS

Preliminary yields and plant height are reported for Monroe and Fair Oaks. Plant height and seed yield for maturity group IV varieties at Monroe are shown in Table 2. Preliminary yields range from below to slightly above yields reported by the farmer for the entire field in recent years. Three cultivars: Dillon, UARK 5896, and Manokin appear to have shown a positive response to subsoiling (Table 3). Cache did not exhibit this response. Plant heights and seed yields of maturity group IV varieties at Fair Oaks are shown in Table 4.

PRACTICAL APPLICATIONS

Yield increases due to subsoiling indicate that soil compaction is likely to be one important factor in yield reduction in the field at Monroe. Definite conclusions cannot be drawn from one year's data, especially regarding varietal differences.

ACKNOWLEDGMENT

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Table 1. Soil type, pH, electrical conductivity and soil test data (Mehlich III) of soybean production fields at Monroe and Fair Oaks, 1998.

Location	Type	pH	EC	P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu
			umhos/cm-1	------------------------------lb/acre ----------------------------									
Monroe[z]	Silt Loam	7.4	170	15	100	3175	645	228	71	75	70	2.7	1.1
Fair Oaks	Silt Loam	7.1	250	45	180	3400	423	119	71	386	150	4.9	1.6

[z] Flood irrigated.

Table 2. Plant height and preliminary seed yield for maturity group IV genotypes at Monroe, 1998.

Variety	Height inches	Seed Yield bu/acre	Variety	Height inches	Seed Yield bu/acre
H4998RR	26	34.7	Dixie 478	34	21.3
Manokin	26	30.7	DP3478	36	21.0
RS499	44	29.8	AT490	34	20.3
H4994	26	28.5	NK RA452	36	19.1
H4994RR	26	25.8	A4922	35	19.1
DK 4762	30	24.8	CF461	34	15.3
NKS4260	28	23.4	HBK4755	31	14.6
A4715	31	22.5	Williams 82	33	13.4
CX494	35	21.5	AT FFR493	32	11.0

Planting date: 3 June 1998
Harvest date: 27 October 1998

Table 3. Effect of subsoiling on plant height and preliminary seed yield of four varieties at Monroe, 1998.

	Plant Height		Seed Yield	
Variety	Subsoiled	Not Subsoiled	Subsoiled	Not Subsoiled
	---------- inches -------		---------- bu/acre--------	
Cache	39	38	47.1	48.7
Dillon	33	30	51.0	41.5
Manokin	28	29	46.1	40.4
UARK5896	35	33	51.8	44.8

Planting date: 3 June 1998.
Harvest date: 27 October 1998.

Table 4. Plant height and preliminary seed yield for maturity group IV genotypes at Fair Oaks, 1998.

Variety	Height inches	Seed Yield bu/acre	Variety	Height inches	Seed Yield bu/acre
DK 4762	26	22.3	AT490	27	14.4
A4715	21	21.8	RS499	29	13.6
A4922	27	20.6	NKS4260	23	13.5
Manokin	20	18.7	H4994RR	24	13.4
CX494	29	16.9	CF461	24	13.0
H4998RR	33	16.7	Williams 82	25	13.0
NK RA452	29	16.4	H4994	24	12.9
HBK4755	24	15.2	AT FFR493	27	10.5
DP3478	26	14.7	Dixie 478	25	9.1

Planting date: 2 June 1998
Harvest date: 13 October 1998

AGRONOMICS OF TRADITIONAL VERSUS SITE SPECIFIC FERTILIZATION

W.E. Sabbe and R.E. DeLong

RESEARCH PROBLEM

The advent of precision agriculture with its inclusion of monitoring yield on a small area allows for fertilizer application via variable rate technology. Prior to precision agriculture the goal of soil sampling was to obtain a sample that contained the mean values of a field. Traditional fertilization practices applied a uniform fertilizer rate to the entire field based on a field average. Precision agriculture allows for numerous fertilizer and application rates within a field based on the soil analyses for each specific area. Therefore, the correlation and calibration data must be precise to allow for grower and applicator confidence in the process. Additionally, the cropping system that contains the soybean response must be documented as to nutrient uptake and nutrient removal to facilitate the timing and rates of fertilizer application.

BACKGROUND INFORMATION

Soybean response to fertilizer phosphorus (P) on soils having low soil test P values has been inconsistent over the past 20 years. The yield responses have been low (2 to 5 bu / acre) and the fertilizer rate responsible for those increases varies among locations and years. While responses to potassium (K) fertilizer have been more consistent than responses to P fertilizer, variations still exist. A recent study on Arkansas soils indicated that P and K fixation values ranged up to 60% of the applied P and 30% of the applied K. Much of the P fixation occurred within 16 hours after application, whereas, the K fixation values were higher at 60 days after application.

RESEARCH DESCRIPTION

The study was conducted in 1997 and 1998 at the Arkansas Agricultural Research and Extension Center (AAREC) in Fayetteville on a Captina (Typic Fragiudults, fine-silty, mixed, thermic) silt loam. Cultivars H5218 and 'Hutcheson' were planted in 1997 and 1998, respectively, with 10-ft-wide by 25-ft-long plots with 38-inch rows. The study was a comparison among responses from phosphorus and potassium fertilizer rates based on rates of nontreated, field average, and site specific soil test levels. The field average for P was 53 lb / acre and K was 156 lb / acre and the corresponding recommended fertilizer rate was 40 lb P_2O_5 / acre and 60 lb K_2O / acre. The fertilization rates for the site specific areas were 0-0, 0-30, 0-60, 40-30, 40-60, 40-90, 45-90, and 60-120 lb P_2O_5-K_2O / acre, respectively. P_2O_5 and K_2O fertilizer rates for the field average and site specific methods were applied broadcast and incorporated before planting. Leaf and whole plant samples were obtained at the R3 growth stage. Grain yields were also determined.

RESULTS

Nutrient uptake shown by leaf analysis for P and K in 1997 was not significant for fertilizer treatment or method of fertilizer placement (data not shown). Nutrient uptakes shown by leaf analyses for P and K in 1998 were significant for methods of fertilizer placement (Table 1). P, K, calcium (Ca), and Magnesium (Mg) uptake ranged from 0.29 to 0.34, 1.05 to 1.45, 1.46 to 1.86, and 0.21 to 0.32 % overall, respectively. Phosphorus, potassium, calcium, and magnesium uptakes were significant in 5, 6, 4, and 4 out of 7 fertilizer treatments for rates of fertilizer, respectively. In the same fertilizer treatment, calcium and magnesium uptake were both significant for the rate of fertilizer only when phosphorus and potassium uptake were both significant by increased fertilizer rate. Nutrient uptake shown by whole plant analysis for P and K in 1997 and 1998 was not significant for fertilizer rate (data not shown). Grain yields for the fertilizer treatments were not significant in 1997 and 1998 with yields ranging from 48.6 to 59.3 and 21.9 to 34.4 bu / acre overall, respectively (Table 2). The reduction in grain yields in 1998 were due to the elevated temperatures during the reproductive growth stages.

Table 1. Nutrient uptake by leaves as affected by phosphorus and potassium fertilizer as applied by field average or site specific methods, Arkansas Agricultural Research and Extention Center, Fayetteville, 1998.

Fertilizer Treatment	Fertilizer Placement Method	P	K	Ca	Mg
lb P_2O_5 - K_2O/acre		----------------------	%	----------------------	
0-30	Nontreated	0.30	1.10	1.67	0.29
	Field Average[z]	0.31	1.27	1.55	0.29
	Site Specific	0.30	1.30	1.54	0.26
	$LSD_{(0.05)}$	NS[y]	0.15	NS	NS
0-60	Nontreated	0.30	1.05	1.86	0.26
	Field Average	0.31	1.25	1.66	0.23
	Site Specific	0.30	1.22	1.66	0.24
	$LSD_{(0.05)}$	0.01	0.06	0.13	0.02
40-30	Nontreated	0.30	1.26	1.51	0.29
	Field Average	0.34	1.42	1.51	0.28
	Site Specific	0.32	1.36	1.46	0.29
	$LSD_{(0.05)}$	0.03	NS	NS	NS
40-60	Nontreated	0.29	1.06	1.83	0.27
	Field Average	0.32	1.28	1.66	0.23
	Site Specific	0.32	1.35	1.60	0.23
	$LSD_{(0.05)}$	0.02	0.13	0.15	0.03
40-90	Nontreated	0.31	1.19	1.76	0.24
	Field Average	0.32	1.29	1.72	0.24
	Site Specific	0.32	1.35	1.65	0.21
	$LSD_{(0.05)}$	NS	0.11	NS	NS
45-90	Nontreated	0.29	1.05	1.75	0.32
	Field Average	0.31	1.23	1.64	0.29
	Site Specific	0.31	1.30	1.52	0.28
	$LSD_{(0.05)}$	0.02	0.16	0.21	0.03
60-120	Nontreated	0.30	1.07	1.77	0.26
	Field Average	0.32	1.30	1.64	0.23
	Site Specific	0.33	1.45	1.55	0.21
	$LSD_{(0.05)}$	0.02	0.08	0.12	0.03

[z] Original soil test levels for field average; phosphorus = 53 lb P/acre and potassium = 156 lb K/acre for a corresponding recommended rate of 40-60 lb P_2O_5 - K_2O/acre.

[y] NS = not significant.

Table 2. Irrigated soybean grain yield as affected by phosphorus and potassium fertilizer as applied by field average or site specific methods, Arkansas Agricultural Research and Extension Center, Fayetteville, 1998.

Fertilizer Treatment	Fertilizer Placement Method	Yield 1997	 1998
lb P_2O_5 - K_2O/acre		------------ bu/acre ----------	
0-30	Nontreated	59.3	32.1
	Field Average[z]	57.9	31.1
	Site Specific	58.8	34.4
	$LSD_{(0.05)}$	NS[y]	NS
0-60	Nontreated	57.9	32.1
	Field Average	58.8	28.7
	Site Specific	56.6	32.4
	$LSD_{(0.05)}$	NS	NS
40-30	Nontreated	48.8	25.4
	Field Average	50.8	22.9
	Site Specific	48.6	21.9
	$LSD_{(0.05)}$	NS	NS
40-60	Nontreated	52.1	26.9
	Field Average	54.4	25.5
	Site Specific	55.3	28.7
	$LSD_{(0.05)}$	NS	NS
40-90	Nontreated	54.7	29.7
	Field Average	53.5	28.4
	Site Specific	55.2	27.1
	$LSD_{(0.05)}$	NS	NS
45-90	Nontreated	55.8	30.0
	Field Average	53.5	30.4
	Site Specific	57.2	28.7
	$LSD_{(0.05)}$	NS	NS
60-120	Nontreated	53.4	27.0
	Field Average	53.0	25.0
	Site Specific	53.1	24.7
	$LSD_{(0.05)}$	NS	NS

[z] Original soil test levels for field average; phosphorus = 53 lb P/acre and potassium = 156 lb K/acre for a corresponding recommended rate of 40-60 lb P_2O_5 - K_2O/acre.

[y] NS = not significant.

GRAIN YIELD OF DOUBLE CROP WHEAT AND SOYBEAN AS AFFECTED BY FERTILIZER, LIME, AND IRRIGATION

W.E. Sabbe and R.E. DeLong

RESEARCH PROBLEM

Cropping systems allow for the input of fertilizer at various times during the cycle of the system. The timing can be a decision based on fertilizer price, suitability of weather and field conditions, and economic return based on specific crops. The objectives of this study were to include the inputs of fertilizer rate and timing, lime application, and irrigation on a wheat / soybean cropping system (two crops per year).

BACKGROUND INFORMATION

The wheat / soybean cropping system is popular in Arkansas and allows several opportunities for inputs. Also, this intensive cropping system (two crops per year) should demonstrate responses to lime and fertilizer. The inclusion of irrigation versus dryland involves the parameter of soil moisture into the expected responses. Current recommendations are to apply phosphorus (P) and potassium (K) fertilizer during the wheat portion of the cycle; however, no timing recommendation is given for limestone during this cycle, nor is irrigation a factor in the timing of either the fertilizer or limestone application.

RESEARCH DESCRIPTION

The wheat / soybean double crop study was conducted at the Pine Tree Branch Experiment Station (PTBES) in Colt, and consisted of three sites with four replications each. Wheat cultivars ‘Jackson’, NK Coker 9543, and Shiloh were harvested in 1995, 1996, and 1998, and soybean cultivars H5164, ‘Hutcheson’, and Hutcheson were harvested in 1995, 1996, and 1997, respectively. The first site was irrigated and a comparison between a starter P_2O_5-K_2O rate of 60-30 or 80-80 lb / acre with subsequent fertilizer treatment of 80-80 in the fall of 1995. The second site was irrigated and a comparison of none and a recommended lime rate of 2.5 tons / acre. The third site was dryland and a comparison between a P_2O_5-K_2O fertilizer rate of 80- 80:0-0:60-30:0-0:60-30:0-0 or 80-80:40-60:80-80:40-60:80-80:40-60 lb / acre for the three cropping seasons. Both sites were located on a Calloway (Glossaquic Fragiudalfs, fine-silty, mixed, thermic) soil with an initial Mehlich III value where P=33 and K=284.

RESULTS

In the first study (Table 1) there were no significant differences between the two starter fertilizer rates for the three years. In the second study (Table 2) a significant difference was evident in 1996 for soybean with a 2.7 bu / acre increase in yield for 2.5 T lime / acre over the control. In the third study there were no significant differences between the two fertilizer rates for the three years.

PRACTICAL APPLICATIONS

Statistically the data revealed no consistent effects due to P and K fertilizer timing or limestone application. The trends were directed toward a soybean grain yield response from the limestone application. However, continued research will be needed to justify the differences.

ACKNOWLEDGMENT

Financial support from the Arkansas Fertilizer Tonnage Fee is appreciated.

Table 1. Double crop wheat and irrigated soybean grain yield as affected by phosphorus and potassium starter fertilizer, Pine Tree Branch Experiment Station, Colt, 1995-1998.

Starter Fertilizer	Wheat			Soybean		
(P_2O_5-K_2O)	1995	1996	1998	1995	1996	1997
lb/acre	------------ bu/acre ------------					
60-30	61.1	50.1	53.0	37.3	45.4	40.0
80-80	59.3	48.4	58.8	35.2	44.3	42.8
$LSD_{(0.05)}$	NS[z]	NS	NS	NS	NS	NS

[z] NS = not significant.

Table 2. Double crop wheat and irrigated soybean grain yield as affected by lime, Pine Tree Branch Experiment Station, Colt, 1995-1998.

	Wheat			Soybean		
Lime	1995	1996	1998	1995	1996	1997
T/acre	------------ bu/acre ------------					
0	62.6	50.6	48.6	35.3	36.4	41.2
2.5	62.3	56.0	51.6	39.4	39.1	41.2
$LSD_{(0.05)}$	NS[z]	NS	NS	NS	NS	NS

[z] NS = not significant.

Table 3. Double crop wheat and dryland soybean grain yield as affected by phosphorus and potassium fertilizer, Pine Tree Branch Experiment Station, Colt, 1995-1998.

Fertilizer Treatment											
Fall	Spring	Fall	Spring	Fall	Spring	Wheat			Soybean		
1994	1995	1995	1996	1996	1997	1995	1996	1998	1995	1996	1997
-------- lb P_2O_5-$K_2$0/acre --------						-------- bu/acre --------					
80-80	0-0	60-30	0-0	60-30	0-0	61.1	62.5	53.9	17.3	34.0	32.6
80-80	40-60	80-80	40-60	80-80	40-60	58.5	64.8	51.6	15.7	33.0	30.5
$LSD_{(0.05)}$						NS[z]	NS	NS	NS	NS	NS

[z] NS = not significant.

INFLUENCE OF PHOSPHORUS PLUS POTASSIUM FERTILIZER ON GRAIN YIELD OF CONTINUOUS WHEAT

W.E. Sabbe and R.E. DeLong

RESEARCH PROBLEM

The predicted response of wheat grain yield to phosphorus (P) and potassium (K) fertilizer indicates that the size of the response increases as yield potential increases. This proportional response dictates that fertilizer applications are most economical when cultural management practices allow a high yield potential. The objective of this study was to vary the P and K fertilizer rate and evaluate grain yield and nutrient uptake under continuous wheat conditions.

BACKGROUND INFORMATION

Previous fertility studies with wheat have involved the crop in rotation with other row crops. The nutritional requirements for continuous wheat needs to be further addressed with variable phosphorus and potassium fertilizer applications and subsequent nutrient uptake.

RESEARCH DESCRIPTION

The studies designated as North and South were initiated at the Pine Tree Branch Experiment Station (PTBES) in Colt, on a Calloway (Glossaquic Fragiudalfs, fine-silty, mixed, thermic) soil. The studies were planted with the Shiloh cultivar in 1998 with 5-ft-wide and 40-ft-long plots with 7-inch rows. The respective soil test values at the North and South studies were 26 lb P/acre and 178 lb K/acre and 22 lb P/acre and 158 lb K/acre. The two fertilizer rates were 0-0 and 60-30 (P_2O_5-K_2O) lb/acre with the fertilizer applied broadcast prior to incorporation and planting.

RESULTS

The North Study did not produce a significant yield difference for the fertilizer treatments (Table 1). The 60-30 fertilizer treatment compared to the check had a significantly greater uptake of P and K with 10.9 to 8.6 and 89.0 to 80.0 mg/plant, respectively. The South Study indicated no significant differences for yield between the two fertilizer treatments (Table 2). The 60-30 fertilizer treatment compared to the check had a significantly greater uptake of P with 9.7 to 7.7 mg/plant, respectively.

PRACTICAL APPLICATIONS

The application of phosphorus and potassium fertilizer resulted in increased P uptake in both studies and K uptake in one study. However, the fertilizer treatment did not significantly increase yield in either study. Further study of P and K fertilizer in these sites with continuous wheat will be conducted.

ACKNOWLEDGMENT

Financial support from the Arkansas Fertilizer Tonnage Fee is appreciated.

Table 1. Wheat grain yield and phosphorus (P) and potassium (K) whole plant analysis in the North Study as affected by phosphorus and potassium fertilizer, Pine Tree Branch Experiment Station, Colt, 1998.

Fertilizer Treatment		Whole Plant[z]	
(P_2O_5-K_2O)	Grain Yield	P	K
lb/acre	bu/acre	--------- mg/plant ---------	
0-0	56.7	8.6	80.0
60-30	57.3	10.9	89.0
$LSD_{(0.05)}$	NS[y]	0.6	5.4

[z] Sampled at R3 growth stage.
[y] NS = not significant.

Table 2. Wheat grain yield and phosphorus (P) and potassium (K) whole plant analysis in the South Study as affected by phosphorus and potassium fertilizer, Pine Tree Branch Experiment Station, Colt, 1998.

Fertilizer Treatment		Whole Plant[z]	
(P_2O_5-K_2O)	Grain Yield	P	K
lb/acre	bu/acre	-------- mg/plant --------	
0-0	41.1	7.7	79.0
60-30	40.1	9.7	83.5
$LSD_{(0.05)}$	NS[y]	0.7	NS

[z] Sampled at R3 growth stage.
[y] NS = not significant.

INFLUENCE OF PHOSPHORUS PLUS POTASSIUM FERTILIZER AND IRRIGATION ON GRAIN YIELDS OF SOYBEAN CULTIVARS

W.E. Sabbe and R.E. DeLong

RESEARCH PROBLEM

The predicted response of soybean grain yield to phosphorus (P) and potassium (K) fertilizer indicates that the size of the response increases as yield potential increases. This proportional response dictates that fertilizer applications are most economical when cultural management practices allow a high yield potential. The objective of this study was to vary the cultural management practices of irrigation and cultivar selection such that the effect of a fertilizer application could be evaluated under various yield potentials of traditional and Roundup Ready (RR) soybean cultivars.

BACKGROUND INFORMATION

Previous fertility studies have involved only a single cultivar at each location. Grain yield response to fertilizer applications has been reported on both alluvial and loessial soils with the response to K fertilizer occurring more often than response to P fertilizer. Also, as the soil's clay content increases, the level of response decreases, regardless of soil fertility levels, probably due to an increase in the soil's replenishment capacity. Arkansas climate allows for the success of several soybean cultivar maturity groups (MG) IV to VII with the majority of acreage devoted to MG V and VI under dryland situations. The interaction of traditional and RR soybean cultivars, irrigation, and fertilizer application at various locations has not been investigated.

RESEARCH DESCRIPTION

Two locations were selected such that an alluvial soil at the Southeast Branch Station (SEB), Rohwer, and a loessial soil at the Cotton Branch Station (CBS), Marianna, were included. The alluvial soil was the Desha series (Vertic Hapludolls, very-fine, mixed, thermic), and the loessial soil was the Calloway series (Typic Glossaquic, fine-silty, mixed, thermic). At each location a dryland site and an irrigated site were utilized. The respective soil test values at SEB and CBS were 67 lb P / acre and 220 lb K / acre and 34 lb P / acre and 190 lb K / acre. At the CBS in 1998, eight RR cultivars were utilized including three in MG IV (DG4650RR, DK4762RR, and H4994RR), three in MG V (AP588RR, SF567RR, and TV5666RR), and two in MG VI (SG618RR and SG678RR). The eight traditional cultivars at the SEB in 1998 included two in MG IV (Dixie478 and 'Manokin'), four in MG V (DP3588, H5050, H5547, and 'Hutcheson'), and two in MG VI (P9611 and TN6-90). The two fertilizer rates were 0-0-0 and 0-60-120 (N-P_2O_5-K_2O) pounds per acre with the fertilizer applied broadcast prior to incorporation and planting. Individual plots consisted of four 38-inch rows with a length of 20 ft and 12 replications at CBS and five 19-inch rows with a length of 25 ft and eight replications at SEB.

RESULTS

The 1995 growing season for the SEB included an extended dry period, which resulted in low dryland grain yields (Table 1). The average yields among cultivars in 1995 ranged from 4.2 to 20.4 and 33.0 to 51.5 bu / acre for SEB dryland and irrigated sites, respectively. The average yields among cultivars in 1996 for the SEB ranged from 25.8 to 36.0 and 37.7 to 54.6 bu / acre for SEB dryland and irrigated sites, respectively. The SEB 1998 dryland site was abandoned due to a poor plant stand, but the average yield in bu / acre for the irrigated cultivars ranged from 27.1 to 56.8. At the CBS the average yields among RR cultivars ranged from 14.7 to 21.9 and 33.7 to 40.7 bu / acre for dryland and irrigated sites, respectively (Table 2). There were no responses to the fertilizer treatment for either the dryland or the irrigated sites at either location. The significant differences among maturity groups were evident for the SEB MG V appearing to have the highest yield except for MG VI in 1998. At the CBS the yield for MG VI was significantly higher than for MG V.

PRACTICAL APPLICATION

Selection of cultivar had a greater affect than fertilizer rate in the obtainment of higher yields. Obviously irrigation did produce the greatest yields, but even at that higher yield potential, maturity group and cultivar selection appeared to have a greater effect than fertilizer application.

Table 1. Interactions of location, phosphorus and potassium fertilizer, maturity group (MG), and irrigation on soybean grain yields, Southeast Branch Station, Rohwer, 1995-1998.

	Dryland						Irrigated					
	0-0-0			0-60-120			0-0-0			0-60-120		
Cultivar (MG)	1995	1996	1998	1995	1996	1998	1995	1996	1998	1995	1996	1998
	-----	-----	-----	-----	-----	----- bu/acre -----	-----	-----	-----	-----	-----	-----
A4715 (IV)	15.8	28.7	*[z]	14.9	25.8	*	36.4	38.1	*	36.6	37.7	*
Dixie478 (IV)	*	*	—[y]	*	*	*	*	*	27.9	*	*	27.1
Manokin (IV)	17.9	29.5	—	17.7	33.0	—	41.2	45.8	25.9	42.1	46.8	30.3
A5403 (V)	15.9	29.3	*	17.9	29.4	*	42.5	41.0	*	42.6	44.0	*
DP3588 (V)	*	*	—	*	*	—	*	*	52.8	*	*	51.3
H5050 (V)	*	*	—	*	*	—	*	*	45.3	*	*	42.2
H5545 (V)	*	36.0	*	*	34.2	*	*	52.7	*	*	53.1	*
H5547 (V)	*	*	—	*	*	—	*	*	32.5	*	*	27.2
Hutcheson (V)	18.3	34.8	—	20.4	36.0	—	51.5	54.6	30.1	50.7	54.3	31.6
RS577 (V)	15.4	*	*	15.4	*	*	48.5	*	*	44.5	*	*
TV5797 (V)	*	34.5	*	*	29.6	*	*	42.3	*	*	41.3	*
A6711 (VI)	*	34.8	*	*	35.8	*	*	45.2	*	*	42.7	*
A6297 (VI)	4.2	*	*	4.1	*	*	33.0	*	*	33.1	*	*
H6688RR (VI)	10.0	*	*	8.2	*	*	43.9	*	*	44.4	*	*
P9611 (VI)	*	30.7	*	*	27.9	*	*	45.6	52.8	*	45.4	56.8
P9641 (VI)	11.0	*	*	13.0	*	*	46.3	*	*	44.1	*	*
TN6-90 (VI)	*	*	—	*	*	—	*	*	46.7	*	*	47.7
LSD$_{(0.05)}$	3.1	5.9	—	3.1	5.9	—	3.3	4.5	7.5	3.3	4.5	7.5

Main Factors	**1995**	**1996**	**1998**
1) Irrigation			
None	13.7	31.9	—
Irrigated	42.6	45.7	—
LSD$_{(0.05)}$	3.2	3.1	—
2) Fertilizer			
0-0-0	28.2	39.0	39.2
0-60-120	28.1	38.6	39.3
LSD$_{(0.05)}$	NS	NS	NS
3) Maturity Group			
IV	27.8	35.7	27.8
V	32.0	40.4	39.1
VI	24.6	38.5	51.0
LSD$_{(0.05)}$	6.4	1.7	4.1

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[z] '*' = Cultivar was not included in the test.

[y] '—' = Dryland study was not harvested due to poor stand.

Table 2. Interactions of location, phosphorus and potassium fertilizer, maturity group (MG) and irrigation on RR soybean grain yields, Cotton Branch Station, Marianna, 1998.

	Dryland		Irrigated	
Cultivar (MG)	0-0-0	0-60-120	0-0-0	0-60-120
	---------- bu/acre ----------			
DG4650RR (IV)	15.7	14.9	40.3	40.7
DK4762RR (IV)	18.5	18.5	37.5	36.6
H4994RR (IV)	17.0	17.7	37.6	38.0
AP588RR (V)	16.5	16.1	37.1	38.1
SF567RR (V)	16.3	16.0	36.2	34.8
TV5666RR (V)	14.7	15.6	35.7	37.1
SG617RR (VI)	17.7	18.2	34.4	33.7
SG678RR (VI)	20.8	21.9	40.2	39.6
LSD$_{(0.05)}$	2.6	2.6	2.7	2.7

Main Factors

1)	Irrigation	
	None	17.2
	Irrigated	37.3
	LSD$_{(0.05)}$	1.6
2)	Fertilizer	
	0-0-0	27.3
	0-60-120	27.3
	LSD$_{(0.05)}$	NS
3)	Maturity Group	
	IV	27.7
	V	26.2
	VI	28.3
	LSD$_{(0.05)}$	2.0

INFLUENCE OF POULTRY LITTER AND PHOSPHORUS ON SOYBEAN GROWN ON SALINE SOILS

J.H. Muir and J.A. Hedge

RESEARCH PROBLEM

Soil salinity is a problem in some areas of Arkansas. The problem is often caused by irrigating with water containing excessive amounts of soluble salts. The salinity problem has evidently become more widespread with the increased use of irrigation. Long-term solutions may include removing salt from irrigation water, or finding sources of water that contain lower levels of soluble salts. Short-term solutions to the salinity problem would be helpful in allowing continued crop production in these areas until long-term solutions are available.

BACKGROUND INFORMATION

Observations from studies in rice have indicated that additions of poultry litter may be beneficial in reclaiming saline soils. There are also indications that phosphorus may compete with chlorides and reduce salt damage. The objective of this study was to determine whether poultry litter and phosphorus amendments might reduce damage to soybeans grown on saline soils.

RESEARCH DESCRIPTION

A study was initiated in 1995 at a Monroe County site with a history of a chloride problem due to use of irrigation water containing high levels of chloride. Residual effects of treatments applied in 1995 were followed through 1997. A new site was selected in the same general area and treatments were applied in 1998. A second site was established at Arkansas State University (ASU), where a saline condition was artificially created. An 'includer' soybean cultivar was grown at each location.

Monroe County

Experimental design: Factorial experiment in a randomized complete block design
Poultry litter treatments: 0, 250, 500, 1,000, 2,000, and 4,000 lb / acre
Phosphorus treatments: 0, 40, 60, and 80 lb P_2O_5 / acre

ASU

Experimental design: randomized complete block with a split-plot arrangement of treatments
Main plots: 0, 2,000, and 4,000 lb / acre KCl
Subplots: factorial arrangement of a) 0, 2,000, and 4,000 lb / acre poultry litter and b) 0, 40, and 80 lb / acre P_2O_5

RESULTS

There have been no significant treatment effects at the Monroe County for any year (Table 1). Drought has been a factor affecting yield each year.

Applied KCl significantly reduced soybean yield in each of the three years following application (Table 2). Although there was a trend for yield reduction in the fourth year, it was not statistically significant. Poultry litter increased yields only in 1996, regardless of KCl treatment. Applied phosphate has had no effect on yields.

PRACTICAL APPLICATION

Poultry litter and phosphorus have had no effect on soybean yields at the Monroe County site. Yield was increased with applied poultry litter in one year in four at ASU but was unrelated to salt level.

ACKNOWLEDGMENT

Financial support of the Arkansas Soybean Promotion Board is appreciated.

Table 1. Influence of applied poultry litter on soybean yield at the Monroe County site, 1995-1998.

Poultry	1995	1996	1997	1998
lb / acre	----------------------------	bu / acre	----------------------------	
0	8.3	23.0	13.2	11.4
250	8.0	23.4	15.7	9.6
500	8.0	22.6	13.3	10.8
1,000	8.5	22.8	13.6	11.6
2,000	7.8	22.8	13.3	9.4
4,000	7.7	22.9	17.3	11.5
$LSD_{(0.05)}$	NS[z]	NS	NS	NS

[z] NS = not significant.

Table 2. Influence of applied KCl on soybean yield at Arkansas State University, Jonesboro, 1995-1998.

KCl	1995	1996	1997	1998
lb/acre	--------------------------------bu/acre			----------------------------
0	35.7	36.1	39.9	34.4
2,000	22.3	31.7	36.8	30.2
4,000	14.8	29.3	35.4	28.5
LSD $_{(0.05)}$	3.1	3.3	3.0	NS[z]

[z] NS = not significant.

Table 3. Influence of applied poultry litter and phosphate on soybean yield at the Arkansas State University, Jonesboro, 1995-1998.

Poultry Litter	Phosphate	1995	1996	1997	1998
--------------- lb/acre	----------------	------------------------	bu/acre	----------------------	
0	0	23.3	28.7	37.0	30.3
0	40	22.2	29.9	36.5	29.7
0	80	22.0	28.6	34.2	39.7
2,000	0	25.9	33.5	28.1	30.9
2,000	40	25.3	32.7	39.6	33.8
2,000	80	23.2	30.1	36.1	28.9
4,000	0	23.0	35.4	28.4	29.6
4,000	40	28.2	34.1	36.6	31.0
4,000	80	25.4	38.3	39.9	35.6
LSD $_{(0.05)}$		NS[z]	NS	NS	NS

[z] NS = not significant.