2008 Missouri Rice Variety Performance Trials

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In 2008 the Missouri Rice Council, University of Missouri-Delta Center and Southeast Missouri State University conducted the Missouri rice variety trials as a cooperative effort. These trials are conducted as a service to Missouri rice producers to provide a reliable, unbiased, up-to-date source of information for comparing rice varieties grown in the southeast Missouri environment.

Experimental Procedure

Location

Rice plots were established at two locations in 2008: the Missouri Rice Research Farm near Glennonville, MO and at the Delta Center Farm at Portageville, MO. The Rice Research Farm yield trial consisted of drill-seeded plots following soybeans, drill-seeded plots following rice and water-seeded plots following rice which were planted on 16 April, 6 May and 6 May, respectively on a Crowley silt loam. The plots at the Delta Center were drill seeded on 23 May on a Sharkey clay. The seed planted in the water seeded trial were treated with Apron-Maxim-Zinc for rice water weevils. The trial consisted of 24 public, private, and experimental varieties.

Field Plot Design

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches. The water seeded plot size was 12 foot long by 4.4 feet wide.

Entries

Seed of all public varieties were obtained from: Karen Moldenhauer – UA, Stuttgart, AR; Steve Linscombe – LSU, Crowley, LA; Anna McClung – USDA-ARS, Beaumont, TX; Dwight Kanter – MSU, Stoneville, MS, RiceTec and Horizon Ag.

Plot Management

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 180 lb nitrogen. No adjustments in rates were made to meet specific requirements of individual varieties. In the water seeded trial 60 lb urea was applied post emergence, 60 lb N applied at panicle initiation and 60 lb N applied 14 days later.

For primary weed control, 12 oz. Command applied post plant, 2 pts. Prowl, 2 oz. Aim, 78 oz. Permit, 4 qt. Rice Shot and ¾ lb. Facet per acre were applied prior to flooding. There were no insecticides applied. The flood was maintained throughout the growing season. The plots at the Rice Research Farm were harvested with an Almaco research plot combine while Kincaid plot combine was used at the Delta Center. The grain from the plots was weighed and moisture was determined.

Data Recorded

Data was recorded for: emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field Milling quality was determined in the laboratory. Emergence date was the date there were ten plants per square foot on the drill-seeded trial and ten plant per square foot emerged from the water surface in the water-seeded trial. The days to 50% heading was determined from the number of days from emergence to the presence of 50% of the panicles at least partially emerged from the boot. Plant height was taken as the average distance in inches from the soil surface to the top of the panicle on the plant. Lodging, which indicates the degree of erectness, was scored on a scale of 0 to 10 with 0 indicating all plants in a plot were erect (no lodging) and 10 indicating all plants were lodged. Yields were adjusted to 12 percent moisture and reported on a bushel per acre basis. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

RESULTS

The Missouri Rice Variety Trials resulted in optimum yields for three of the four management practices they were tested under; while the yields in the conventional drill trial at the MO Rice Farm were low due to yield limiting plant stands as a result of cool early season growing conditions and some shattering due to high winds just prior to harvest. There were no diseases observed and no other problems were seen during the growing season.

Yield (Table 1, 2 and 3) Location Averages

The yields averaged 114, 174 and 199 Bu/A respectively for the conventional drill test (MO Rice Farm), continuous rice drill test (MO Rice Farm) and conventional drill test (UM Delta Center) while the water-seeded test (MO Rice Farm) averaged 138 Bu/A. The Delta Center yields were higher than expected as the plot area was not on newly cut ground and it was hard to maintain a consistent flood throughout the growing season. The water-seeded trial yields were higher than expected in light of higher lodging than observed in previous years.

Long Grain Type (Table 1)

Differences among varieties were observed across all trials. The top yielding line across all trials was RU0202195 followed by Cybonnet, Trenasse, and Cocodrie.   In the conventional drill-seeded trial at the Missouri Rice Farm RU0603075 was the top yielding lines at 158 Bu /A followed by Cybonnet, Bowman and CL171-AR.   In the conventional drill-seeded trial at the UM Delta Center Trenasse was the top yielding line at 225 Bu /A followed by RU0202195, Cheniere, and Cocodrie. In the continuous rice drill-seeded trial at the Missouri Rice Farm RT XL723 topped the test at 219 Bu/A followed by Cybonnet, RU0202195, and Cocodrie. The top yielding line in the water-seeded trial was RU0603075 at 176 Bu /A followed by CL171-AR, CL131, CL151 and RT XL723.

The only new long grain release was Catahoula which yielded 145 Bu /A across four locations.

Medium Grain Type (Table 1)

The top yielding line across all trials was Neptune, a new medium grain release, at 174 Bu/A followed by RU0002146, Jupiter and Bengal. Jupiter was the top line in the Missouri Rice Farm conventional drill-seeded trial (140 Bu/A). Neptune was the top line in the UM Delta Center conventional drill-seeded trial (240 Bu/A), Missouri Rice Farm water-seeded trial (159 Bu/A) and continuous rice drill-seeded trial (192 Bu/A).

Multiple Years (Table 2)

When comparing long grain varieties across 2007 - 2008 those drill-seeded varieties that yielded well were RU0202195, Trenasse and Wells followed by Cocodrie and RT XL723. Across multiple years, 2003 to 2008, Wells and Francis have been the best yielding varieties.

RU0002146 was the best medium grain variety in 2006 – 2008 in the drill-seeded trials and RU9902028 does yield significantly more than Bengal over years.

Days to Emergence (Table 3).

In 2008 the difference in number of days from planting to emergence between continuous rice water-seeded (9 days) and continuous rice drill-seeded emergence (23 days) was 14 days. Twenty three days were required for the MO Rice Farm trial to emerge while the Delta Center trial required nine days to emerge.

The Days to 50% Heading (Table 3).

Days to 50% heading was taken in all of the trials. The water-seeded trial required nine days fewer than the conventional drill-seeded trial, the continuous rice trial, and Delta Center drill-seeded trial. In the water-seeded trial the average number of days to 50% heading was 78 days and 87 days was the average for the other trials. The range of the difference between the different trials was 16 days. The average number of days to 50% heading observed for the varieties in the combined trials ranged from 72 days for Spring to 95 days for RU0603075.

Plant Height (Table 3)

The 2006 average plant heights were 37 inches for the MO Rice Farm, UM Delta Center drill-seeded trials and water-seeded trial and 41 inches for the continuous rice trial.

Lodging (Table 3)

Lodging averaged 60% in the MO Rice Farm trial, 20% in the continuous rice trial, 10% in the Delta Center trial and 70% in the water-seeded trial across all varieties.

Milling Quality (Table 1 and 3)

Average percent milling quality values across all trials was 73/66. The continuous rice trial had the lowest overall milling quality values at 73/64 and the UM Delta Center trial had the highest at 72/68. The MO Rice Farm averaged 73/65. In 2008 the differences between the three locations for percent total rice were small (1%) but larger (4%) for percent whole rice. The percent head yield scores in the ranged from 53 to 72, much higher than observed in previous years. The highest consistency across the different trials was observed in the medium grain types particularly the variety, Neptune, which had the same overall value as Jupiter and RU0002146. Francis had the lowest milling quality values across the different trials.

The higher milling quality values may have been the result of moderately cool drying conditions from September through the end of harvest. No significant disease symptoms were observed in 2008.

Rice Disease Data

No significant disease symptoms were observed in 2008.

Table 1.

2008 Rice Variety Yield and Milling Quality Average									
	Bushels Per Acre					% Total Rice / % Whole Rice			
Variety	MO Rice Farm	Continuous Rice	Water-Seeded	UM Delta Center		MO Rice Farm	Continuous Rice	Water-Seeded	UM Delta Center
Bowman	135	134	146	166		72/53	69/54	72/62	71/61
Catahoula	110	191	144	133		77/66	74/62	76/67	75/67
Cocodrie	111	198	122	217		75/65	74/65	74/68	74/69
Cheniere	103	138	132	218		75/63	74/64	75/64	75/68
CL131	108	185	158	168		77/67	74/64	75/69	76/72
CL151	121	169	157	187		75/66	72/60	74/66	69/68
CL161	122	152	149	151		76/66	72/59	74/68	73/66
CL171-AR	125	150	170	149		76/67	75/64	75/68	73/67
Cybonnet	135	215	144	166		74/64	75/65	74/68	74/67
Francis	118	172	115	212		72/58	73/62	74/65	71/64
Spring	58	141	113	174		74/69	74/66	74/66	73/66
Trenasse	119	178	127	225		72/60	72/60	73/64	72/61
Wells	93	177	139	188		74/58	74/59	74/63	73/62
RT XL723	91	219	150	145		73/57	74/60	74/64	74/67
RU0001108	110	177	142	202		75/63	73/62	75/65	72/67
RU0202195	113	205	143	223		72/63	73/65	75/68	74/70
RU0603075	158	195	176	197		71/60	71/61	70/63	66/60
Jupiter	140	181	126	224		75/72	74/68	74/71	75/72
Neptune	105	192	159	240		74/71	75/70	76/72	75/72
RU0002146	134	189	141	220		77/71	75/69	75/70	73/70
RU9902028	112	136	127	197		75/70	74/71	75/69	77/74

Table 2.

Missouri Rice Variety Trial - Multiple Year Yield Data (Bushels / A)											
	Drill-Seeded						Water-Seeded				
Variety	2008	07-08	06-08	05-08	04-08		2008	07-08	06-08	05-08	04-08
Cocodrie	175	178	186	190	184		122	134	119	121	122
Cheniere	153	170	183	---	---		132	105	108	---	---
CL171-AR	141	156	---	---	---		170	128	---	---	---
Cybonnet	172	174	179	193	191		144	126	104	108	114
Francis	167	182	185	196	193		115	131	116	117	122
Spring	124	146	146	110	88		113	110	96	72	58
Trenasse	174	182	177	132	106		127	111	103	77	62
Wells	152	171	182	191	185		139	159	142	137	149
RT XL723	152	178	195	205	164		150	148	160	156	124
RU0001108	163	175	117	---	---		142	120	101	---	---
RU0202195	180	188	125	---	---		143	133	122	---	---
Jupiter	182	187	198	---	---		126	141	136	---	---
RU0002146	181	194	199	---	---		141	148	136	---	---
RU9902028	148	177	186	---	---		127	136	131	---	---

Table 3.

2008 Rice Variety Agronomic Data - Averaged Across Locations

Variety	Grain Type	Days to 50% Heading	Plant Height (IN)	Percent Lodging	Bushals / Acre	% Total Yield	% Whole Yield
Bowman	L	87	38	2	145	71	58
Catahoula	L	84	39	3	145	76	65
Cocodrie	L	84	42	3	162	74	67
Cheniere	L	84	36	5	148	74	64
CL131	L	84	36	3	154	75	68
CL151	L	82	39	4	158	73	65
CL161	L	89	39	4	144	74	65
CL171-AR	L	86	39	3	148	75	66
Cybonnet	L	84	39	4	165	74	66
Francis	L	84	40	5	154	73	62
Spring	L	76	40	5	122	74	67
Trenasse	L	77	40	5	162	72	61
Wells	L	86	41	5	149	74	60
RT XL723	L	81	42	3	151	74	62
RU0001108	L	82	41	5	158	74	64
RU0202195	L	82	37	3	171	74	66
RU0603075	L	91	40	3	181	70	61
		84	39	4	154	73	64
Jupiter	M	82	37	4	168	74	71
Neptune	M	85	36	3	174	75	71
RU0002146	M	79	40	5	171	75	70
RU9902028	M	80	40	5	143	75	71
		82	38	4	164	75	71

2008 Effect of Planting Date on Rice Varieties

Donn Beighley, Cathy Dickens,
Randy Dickens, Janet Dickens and Bruce Beck

In southeast Missouri there are a narrowing number of rice varieties grown that meet the needs of Missouri rice producers. These varieties are planted as the weather and the field conditions permit during the period from early April to late June. However, the time of planting may vary from year-to-year based on the planting environment. So we attempt to provide as much information possible concerning varietal performance with respect to harvest date, yield, quality and their agronomic traits when planted at different dates between early April and wheat harvest in mid-June.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO on a Crowley silt loam. The plots were planted on: 16 April (mid-April), 1 May (early May), 21 May (late May), 5 June (mid to late June) and 16 June (late June). At each planting date there were six varieties that represent the major rice varieties grown in southeast Missouri as well as four experimental varieties. These varieties were: Catahoula, Francis, Jupiter, Neptune, Trenasse, and Wells.

Field Plot Design

Each planting date was evaluated as a separate trial and all varieties were included at each date. Each test was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Entries

Seed of all public varieties were obtained from: Karen Moldenhauer – UA, Stuttgart, AR and Steve Linscombe – LSU, Crowley, LA.

Plot Management

The drill plots were planted with an Almaco no-till plot drill. For primary weed control, 12 oz. Command was applied post plant, 4 qt. Duet and ¾ lbs. Facet herbicides were applied prior to flooding. A pre-flood fertilizer was applied at a rate of 180 lbs N. The flood was maintained throughout the growing season. There were no insecticides applied. A single row was harvested to determine milling quality. Milling quality was determined on two replications of each variety from each planting date.

Data Recorded

Notes taken on each plot included: Emergence date, days to 50% percent heading, plant height, lodging and any disease reactions observed as well as measuring yield for each variety. Emergence date was noted as the date when ten plants per square foot were emerged. The days to 50% heading is determined by counting the days from emergence to the presence of 50% of the panicles at least partially emerged from the boot[1]. Height was taken as the average distance in inches from the soil surface to the top of the panicle. Lodging, which indicates the degree of erectness, was scored on a scale of 0 to 100 with 0 indicating all plants in a plot were erect (no lodging) and 100 percent indicating all plants were lodged. Total and head milling yield were determined after milling a sample of each variety in the study.

Results

Yield:

In 2008 when the variety yields were averaged for each planting date it was observed that the late May planting date had the highest overall yields at 174 Bu/ A. It was followed by the mid-April (117 Bu/A), early May (115 Bu/A), and mid-June (114 Bu/A) Table 1. In three out of the four previous years the early April planting date resulted in the highest overall yields. However since we were unable to plant the early April date in 2008 we did not have this data. The trend has been observed that yields are lower at the mid-April planting date than either the early April or early May planting dates.

Across all planting dates Francis and Wells were the highest yielding long grain types (126 and 125 Bu/A, respectively) while Jupiter was the highest yielding medium grain type (145 Bu/A). Table 2.

When comparing variety differences at each planting date across years, Jupiter was the top yielding variety in mid- April (142 Bu/A), late May (189 Bu/A) and early June (127 Bu/A) Table 3.

Days to Emergence

The number of days from planting to emergence ranged from 24 days at mid- April to 6 days at the early June planting date. 15 fewer days, on average are required for days from planting to emergence when comparing mid April (24 day average) to mid June date (6 day average).

Neptune and Trenasse continue to have an emergence date that is about one day later than the average of the varieties at all planting dates.

Days to 50% Heading

The average number of days to 50% heading ranged from 79 days at early May up to 87 days at mid-April (Table 1). A similar trend was observed within varieties. Catahoula had the longest average period between emergence and 50% heading date (91 days) and Trenasse had the fewest (77 days) (Table 2).

Plant Height

When averaged across all varieties the plant height did not change noticeably mid- April to the later planted dates. Table 1. There was a similar trend for the individual varieties. Wells was the tallest varieties (42 inches) while Neptune was the shortest varieties (35 inches) when averaged across all planting dates.

Lodging

Lodging was not observed in any of the varieties in 2008.

Milling Yield / Quality

The percent head yield values for 2008 were noticeably higher than previous years and the percent total yield was about the same as observed in previous years. This may have been a result of the slow drying conditions that occurred due to the cooler than normal late season temperatures.

The highest overall milling quality was from the early May date (75/70) and the lowest was the mid-April date (71/65). Table 1.

Across varieties Neptune (76/72) had the highest average milling quality and Wells had the lowest average (75/61). The trend appears to be that the medium grain varieties consistently have the highest milling values across all planting dates and this trend is observed in most years. Table 2.

Summary

The results of the 2008 date of planting yield trials indicates that the late May planting did result in higher yields than later planting dates and that the mid-June yields were the lowest observed of all the planting dates.

The results of the milling quality analysis indicated that the early May date had the best values but there were no major differences trends observed between the early planting dates.

Table 1. 2008 Planting Date Agronomic Trait Averages

Planting Date	Bushels / Acre	Days to 50% Heading	Plant Height (IN)	Percent Lodging	Stand Count	% Total Yield	% Whole Yield
Mid April	117	87	39	7	14	71	65
Early May	115	79	38	6	14	75	70
Late May	174	83	42	2	30	76	69
Mid June	114	82	39	1	---	75	67

Table 2. 2008 Variety Averages Across Four Planting Dates

Variety	Bushels / Acre	Days to 50% Heading	Plant Height (IN)	Percent Lodging	Stand Count	% Total Yield	% Whole Yield
Catahoula	121	87	37	82	15	77	67
Francis	126	85	41	84	26	74	63
Jupiter	145	82	38	88	16	76	71
Neptune	134	83	35	84	21	76	72
Trenasse	117	77	42	79	15	74	65
Wells	125	85	43	84	23	75	61

Table 3. Grain Yield (Bu/A) over Planting Dates and Multiple Years

Variety	Mid-April		Early May		Late May		Mid-June	
	2008	2007 - 2008	2008	2007 - 2008	2008	2007 - 2008	2008	2007 - 2008
Francis	111	158	110	170	182	183	100	96
Jupiter	142	183	122	167	189	190	127	160
Trenasse	88	141	105	144	152	172	122	141
Wells	97	152	104	145	187	190	111	126
Average	110	159	110	157	178	184	115	131

2008 Effect of Flood Depth Study

Donn Beighley, Cathy Dickens,
Randy Dickens, Janet Dickens and Scott Wheeler

As rice production continues to increase in southeast Missouri the effects of different rice production practices are being tested by the rice researchers as an aid to the Missouri rice producer community. The effect of flood depth study was initiated to see if there were either positive or negative effects when rice is produced at different flood depths. Within this trial we were able to evaluate the effect of flood depth on rice water weevil populations. This aspect of rice production is important as energy costs for pumping continue to increase.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO. The plots at the Rice Research Farm were planted on 6 May on a continuous rice field. The trial consisted of four conventional varieties (Bengal, Francis, Trenasse and Wells) to determine if there were varietal effects due to flood depth.

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with six replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 180 lb nitrogen for all lines. For primary weed control, 12 oz. Command applied post plant, 3 qt. Stam and ½ lb. Facet herbicides were applied prior to flooding. There were no insecticides applied. The different flood depths (0, 2, 4, 6, and 8 inches) were maintained throughout the growing season. The zero flood depth was difficult to maintain as there was the problem of backflow from the surrounding field through the drain pipe and the effect of rainfall. The plots were harvested with a research plot combine. The grain from the plots was weighed and moisture was determined.

Data was recorded for: Emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

Results

The average yield of the flood depth study at the MO Rice Farm was 191 Bu/A with the zero inch depth having the highest yield (204 Bu/A) followed by six inches, two inches, four inches and eight inches, respectively. There was not much difference in yield from zero to six inches but at the eight inch depth the yields dropped off by an average of 43 Bu/A. Table 1.

Across the different flood depths Wells had the highest yields (199 Bu/A) while Trenasse and Bengal had the lowest (187 Bu/A). Trenasse was the one variety that steadily decreased in yield as the flood depth increased.

There was a three day difference in number of days to 50% heading between the different flood depths. The average for zero inch flood was 82 days while the other depths averaged 79 days.

The average plant height was 41 inches and there as only a one to two inch difference between flood depths for plant height.

The percent lodging averaged less than 20 percent although there was a slight increase in lodging as flood depth increased.

The average percent whole kernel milling quality was 64 percent with little difference between the zero and six inch depth but the eight inch depth averaged a slight improvement to 66 percent.

Summary

The main effect of increasing flood depth was observed to on the final yield although small effects were observed for days to 50% heading and percent whole rice milling quality. Preliminary indications are that yields are highest at the zero flood depth and do not decrease appreciably until the flood depth approaches eight inches at which time yields did decrease by an average of 43 Bu/A.

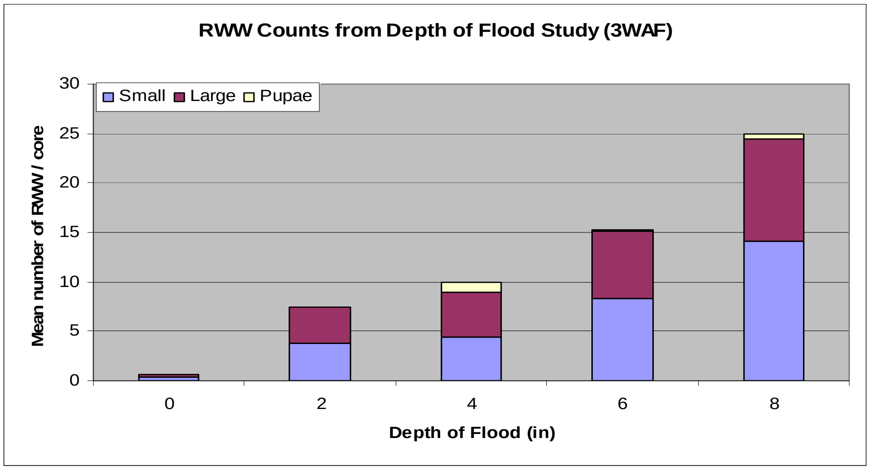
One noticeable difference between the zero flood depth and the other depths was the higher incidence of algae / scum in the alleys. There were definitely fewer weeds in the zero flood depth than the other depths. And the incidence of aquatic weeds appeared to greater as the flood depth increased.

Table 1.

2008 Effect of Flood Depth Study - Agronomic Data						
Flood Depth (Inches)	Bu/A	Days to 50% Heading	Plant Height (In)	Percent Lodging	% Total	% Whole
0" Flood Depth	204	82	41	10	74	64
2" Flood Depth	198	79	40	20	73	63
4" Flood Depth	197	79	41	20	75	63
6" Flood Depth	199	79	41	20	74	64
8" Flood Depth	156	79	42	30	75	66
Average	191	80	41	20	74	64

The Effect of Flood Depth on Rice Water Weevil Counts

Donn H. Beighley and Kelly Tindall



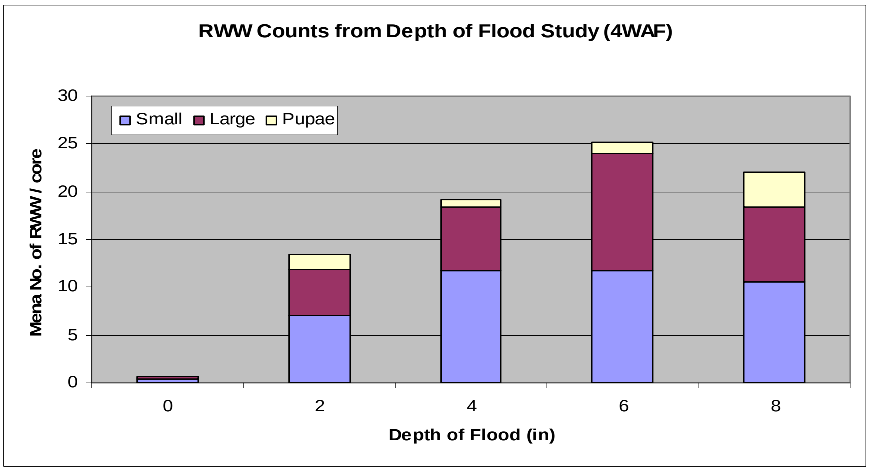


Figure X. Number of rice water weevil per core collected from a depth of flood study. Flood depths were 0, 2, 4, 6, 8 inches.

While there were no significant differences, there is a trend to see fewer numbers of rice water weevil larvae from plots with a shallow flood (Fig. X). This suggests some injury by rice water weevil may be avoided by managing the depth of the flood. However, this practice may be problematic in keeping a shallow flood because of evaporation. More research is needed to determine how long a shallow flood must be maintained to receive maximum benefit.

2008 Bayer Performance Trials

Donn Beighley, Cathy Dickens,
Randy Dickens, and Janet Dickens

As rice production continues to increase in southeast Missouri new varieties are continually being tested by the rice breeding community. The Bayer yield trials were conducted as a service to Missouri rice producers to provide a reliable, unbiased, up-to-date source of information for comparing private and public rice varieties grown in the Southeast Missouri growing environment.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO. The plots at the Rice Research Farm were planted on 16 April on a soybean rotation field and in the continuous rice field on 8 May. The trial consisted of one Bayer hybrid rice line, and three conventional lines.

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with six replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 120 lb nitrogen for the Bayer line and 180 lb nitrogen for the Horizon AG lines. A pre-boot application of 60 lb N was made to the Bayer lines. For primary weed control, 12 oz. Command applied post plant, 3 qt. Stam and ½ lb. Facet herbicides were applied prior to flooding. There were no insecticides applied. The flood was maintained throughout the growing season. The plots at both locations were harvested with a research plot combine. The grain from the plots was weighed and moisture was determined.

Data was recorded for: Emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

Results

The average yield of the Bayer trial at the MO Rice Farm was 139 Bu/A with Arize 1003 leading the conventional management trial with 178 Bu/A and the continuous rice trial was 188 Bu/A with Wells leading the trial with 211 Bu/A.. The conventional trial check lines averaged 126 Bu/A while the continuous rice trial check lines averaged 194 Bu/A.. Table 1 and 2.

The milling quality values for percent head yield ranged from 60% to 72% with an average of 64%. The days to 50% heading ranged from was at 80 days (Jupiter) to 99 days for Arize 1003 with the test average of the trial 88 days. The percent lodging was 80% in the conventional trial and 20% in the continuous rice trial. The plant height of the lines ranged from 33 to 42 inches with an average of 39 inches. There was no disease observed during the growing season.

The new Bayer Agroscience hybrid, Arize 1003, displayed promise in its ability to tiller exceptionally well, yield well across locations and have acceptable milling quality. Its limitation is in the lateness with respect to days to 50% heading. Table 3.

Table 1.

2008 Bayer Yield Trial Agronomic Traits - Rice - Fallow Rotation						
Variety	Bu/A	Days to 50% Heading	Plant Height	Lodging	Total %	Whole %
Arize1003	178	99	37	9	73	60
Francis	118	90	40	9	74	61
Wells	105	91	37	8	74	61
Jupiter	154	86	33	5	76	69
Average	139	92	36	8	74	62

Table 2.

2008 Bayer Yield Trial Agronomic Traits - Continuous Rice Rotation						
Variety	Bu/A	Days to 50% Heading	Plant Height	Lodging	Total %	Whole %
Arize1003	170	90	43	3	73	60
Francis	188	83	41	2	74	66
Wells	211	84	41	2	76	66
Jupiter	182	80	39	1	76	72
Average	188	84	41	2	75	66

Table 3.

2008 Across Location Yields			
Variety	RF	CR	2008 Avg
Arize1003	178	170	174
Francis	118	188	153
Wells	105	211	158
Jupiter	154	182	168

2008 RiceTec Clearfield Hybrid Performance Trials

Donn Beighley, Cathy Dickens,
Randy Dickens, and Janet Dickens

As rice production continues to increase in southeast Missouri new varieties are continually being tested by the rice breeding community. These trials were conducted as a service to Missouri rice producers to provide a reliable, unbiased, up-to-date source of information for comparing private and public rice varieties grown in the Southeast Missouri growing environment.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO. The plots at the Rice Research Farm were planted on 16 April on a Crowley silt loam and at the UM Delta Center on 23 May on a gumbo clay. The trial consisted of four RiceTec hybrid rice lines, and two Horizon AG rice lines.

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with six replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 120 lb nitrogen for the RiceTec lines and 180 lb nitrogen for the Horizon AG lines. A pre-boot application of 60 lb N was made to the RiceTec lines. As part of the study 1.8 oz per Acre of NewPath was applied on 13 May and a second application on 28 May at the MO Rice Farm while applications at the UM Delta Center were made on 5 June and 19 June respectively. For primary weed control, 17 oz. Command applied post plant, 3 qt. Stam and ½ lb. Facet herbicides were applied prior to flooding. There were no insecticides applied. The flood was maintained throughout the growing season. The plots at both locations were harvested with a research plot combine. The grain from the plots was weighed and moisture was determined.

Data was recorded for: Emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

Results

The cool planting conditions and long emergence period resulted in less than optimum plant stands at the MO Rice Farm trial which could have negatively impacted the final yield.
The winds experienced from the hurricanes in September both contributed to a large level of shattering on the hybrid rice varieties and negatively impacted the overall yields in 2008. Table 1.

The average yield of the RiceTec trial at the MO Rice Farm was 115 Bu/A with CL161 leading the trial with 135 Bu/A and at the UM Delta Center was 160 Bu/A with RTCL XL745 leading the trial with 176 Bu/A.. At the MO Rice Farm the RiceTec hybrid Clearfield lines averaged 107 Bu/A while the check lines averaged 132 Bu/A and at the Delta Center the hybrid lines averaged 156 Bu/A while the check lines averaged 169 Bu/A. Table 1.

Looking at the RiceTec hybrids over two years it is observed that RT CLXL745 was the top yielding hybrid at 172 Bu/A followed RT CLXL729 at 167 Bu/A. Table 2.

The milling quality values for percent head yield ranged from 52% to 69% with an average of 61%. The days to 50% heading ranged from was at 82 days (RiceTec CLXP745) to 91 days for CL 161 with the test average of the trial 87 days. The percent lodging was 50 at the MO Rice Farm and zero at the Delta Center. The plant height of the lines ranged from 38 to 43 inches with an average of 39 inches. There was no disease observed during the growing season.

Table 1.

2008 RiceTec Clearfield Yield Trial - UM Delta Center and MO Rice Farm						
	DC	RF	DC	RF	DC	RF
Variety	Bu/A	Bu/A	Shattering	Shattering	Total% / Whole%	Total% / Whole%
CL XP730	153	102	3	4	74/62	75/60
CL XL729	154	115	4	4	75/60	75/63
CL XL745	176	125	4	2	73/59	76/63
CL XP746	139	87	3	5	73/52	73/54
CL161	175	135	2	3	73/66	75/65
CL171AR	164	129	1	2	74/69	76/67

Shattering Score: 1-little or no seed on ground; 5-ground covered in seed

Table 2.

2008 Across Location and Years (207-2008)Yield Average					
	Delta Center	MO Rice Farm	2008 Avg	2007	07 - '08
Variety	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
CL XP730	153	102	127	219	158
CL XL729	154	115	135	230	167
CL XL745	176	125	151	216	172
CL XP746	139	87	113	---	---
CL161	175	135	155	131	119
CL171AR	164	129	146	---	---

Continuous Rice in 2008

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Introduction

Continuous rice production in Missouri is a popular rotation system because of the higher production costs of other crops or inability to rotate particular fields. Producer experiences indicate that yields decrease after the first year of rice production when followed by rice in the same field. The cause of the yield decrease is not known nor what management practices can be taken to maintain yields for fields in continuous rice. Because continuous rice production is a practice already being used throughout southeastern Missouri, we seek to document the practice and propose possible yield protecting solutions through a multiple year research project.

Objective

The objective of this project was to determine the effect of rice diseases, insects, and soil fertility in continuous rice production in Missouri and to propose yield protecting solution to improve yields, milling quality and agronomic traits. An emphasis was placed on soil fertility.

MATERIALS AND METHODS

Drill-seeded, delayed flood continuous rice and soybean-rice rotation studies were conducted at the Missouri Rice Research Farm in fields that have been in continuous rice for four years and also previously planted to soybeans. Each plot consisted of seven rows of the rice variety 'Wells' planted in 12 foot long plots having seven-inch row spacing. A randomized complete block design consisting of three nitrogen rates (i)120, (ii) 150, (iii) 180 lbs N/acre as urea pre-flood and two rates of phosphorus-potassium (i) 0, and (ii) 66 lbs P_2O_5 and K_2O/acre using (4-24-24) were applied preflood. A post plant application of Command and an early post emergence herbicide (Stam and Facet) treatment was applied for weed control.

The physiology study consisted of estimating total nutrient uptake and plant biomass, which was performed by measuring nutrient concentrations at internode elongation and at harvest. Plant biomass was performed by weighing individual plants. Plot analysis will include estimates of (i) the date and extent of emergence, (ii) the degree of tillering, (iii) the date of panicle initiation and 50% heading, (iv) biomass accumulation, (v) nutrient accumulation based on plant tissue testing and biomass accumulation, (vi) and carbon partitioning in seed, (vii) plant height and lodging, and (viii) yield and milling quality. Seed weight per panicle (seed weight / head) was estimated by counting the number of seed per panicle and weighting the weed. Ten replicated per plot were performed

RESULTS AND DISCUSSION

Yield Components and Yields

Seed weights / panicle in the rice after soybeans trial were greater for the 150 and 180 lbs of N/acre treatments than the 120 lbs of N/acre treatment. Within the N treatments, no significant differences were observed because of P and K additions.

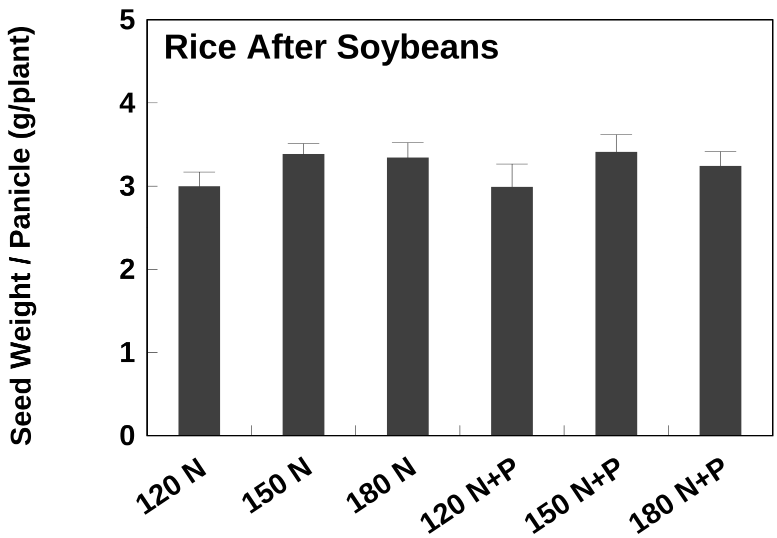


Figure 1. Seed weight / panicle for rice after soybeans

In general, seed weights / panicle were greater in the rice after rice trial than the rice after soybean trial. Seed weights / panicle in the rice after rice trial were not significantly different because of nitrogen treatments. Within a nitrogen treatment, P and K additions promoted greater seed weights / panicle for the 120 and 150 lbs N/acre treatments, whereas P and K treatments reduced seed weights / panicle at the 180 lbs N/acre treatment.

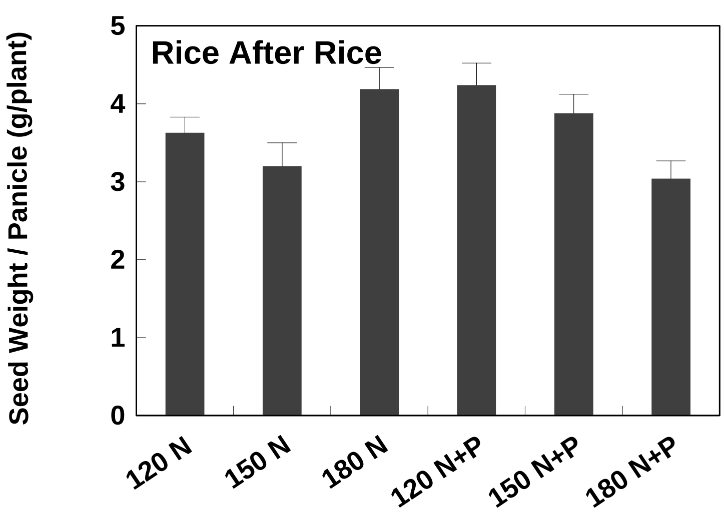


Figure 2. Seed weight / panicle for rice after rice

Yields of (i) rice after soybeans and (i) rice after rice were compared. The yields of rice after rice were greater than the yields of rice after soybeans. Low yields in the rice after soybeans are partially attributed to wind damage caused by remnants of Hurricane Ike that passed through southeast Missouri in September. Lodging and seed dislocation (shattering) occurred primarily in the rice after soybean treatment; however, both crop rotation treatments suffered some lodging and shattering. Rice yields were not significantly influenced by P and K additions, regardless of N treatments or the previous crop.

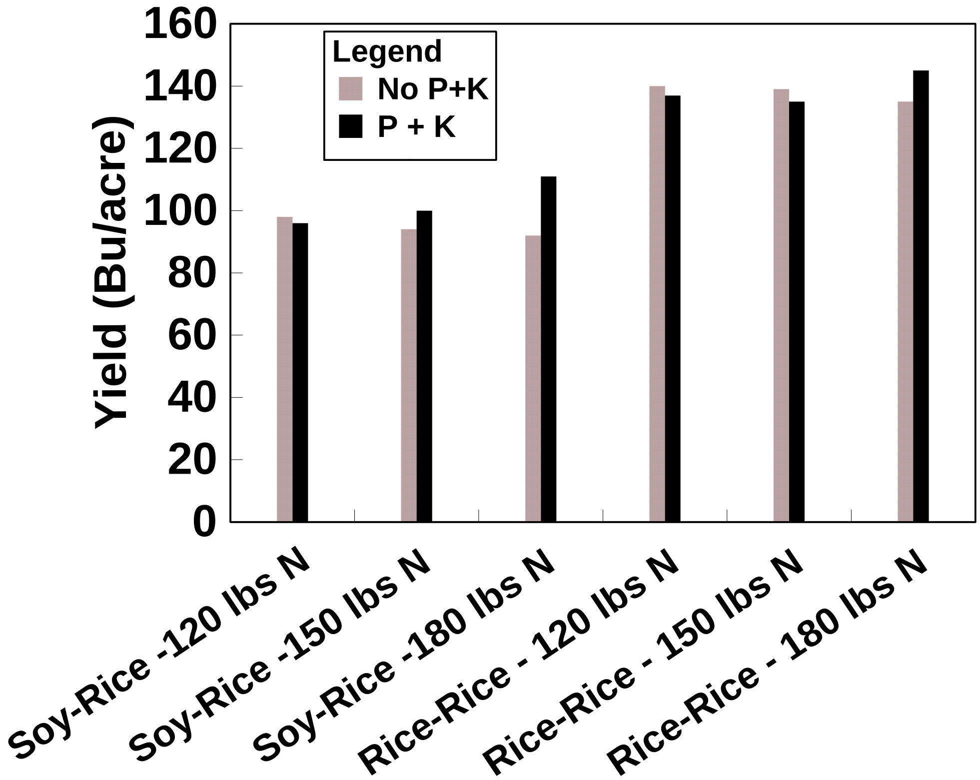


Figure 3. Rice yields for rice after soybeans and rice after rice.

Nutrient Uptake Patterns

Plant Tissue Analysis Prior to Internode Elongation

Plant tissue analysis just prior to internode elongation shows appropriate N, S, P, K, Mg, Ca, Fe, Mn, Cu, Zn and B concentrations for rice after soybeans (Table 1a) and appropriate P, K, Mg, Ca, Fe, Mn, Cu, Zn and B concentrations for rice after rice (Table 1b). Sulfur was slightly deficient and N showed slightly deficient concentrations at the 150 and 180 lbs N/acre rates in rice after rice. Smaller N concentrations at the higher N rates resulted in slightly greater biomass accumulations, which effectively diluted the N concentrations.

Potassium plant tissue concentrations were slightly greater because of P+K additions, but the differences were largely not significant. Phosphorus plant tissue concentrations were not significantly different because of P+K additions. In general, the plant tissue concentrations of S, Mg, Ca, Fe, Mn, Cu, Zn and B were not significantly different because of P+K additions.

Plant Tissue Analysis and plant Biomass Accumulations at Harvest

Plant tissue concentrations and the mean biomass accumulations for vegetation (stem (culm), leaves, and peduncle) and seed for (i) rice after soybeans and (ii) rice after rice are shown in Table 2. Nitrogen, P, K, Mg, Ca, Na, Fe, Mn, B, Cu, and Zn concentrations show dramatic differences between the vegetation and seed compartments, with the seed compartment showing greater concentrations of N, P, Fe, and Cu. Conversely, the vegetation shows greater concentrations of K, Mg, Ca, Na, B, and Zn. Sulfur concentrations were rather evenly distributed between the seed and vegetation.

Rice following soybeans showed greater N, Mg, Ca, Na, and Cu vegetation concentrations, whereas rice following rice showed greater P, K, and Mn vegetation concentrations. Seed concentrations showed that rice after soybeans had greater Mn and Zn concentrations, whereas all of the other nutrients showed no significant differences. The influences of P +K additions were largely not significantly different, especially for the seed component.

The ratio of N/K is significantly greater for rice following soybeans than rice following rice. A large N/K ratio is frequently associated with lodging, which corresponds with the lodging observed in the rice following soybean treatment.

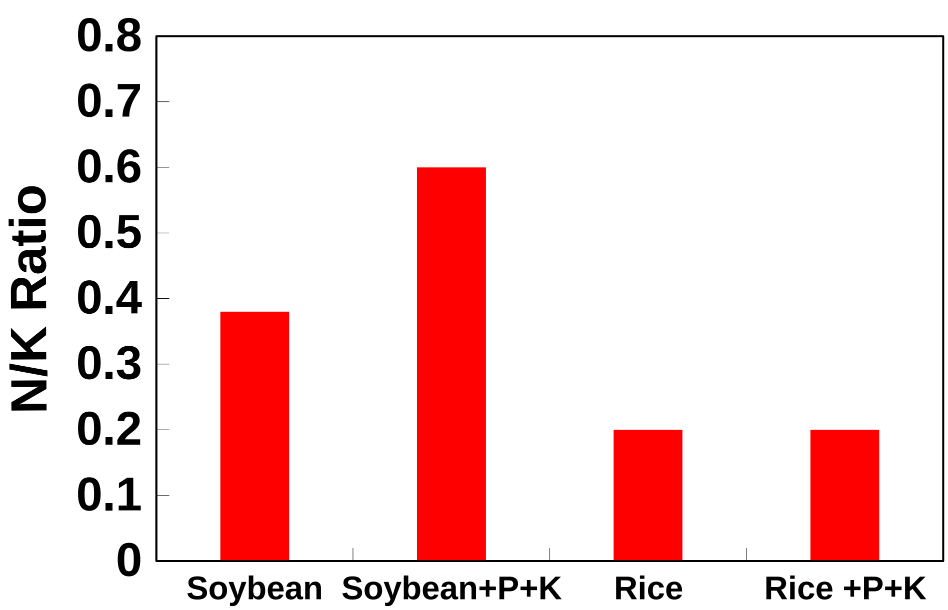


Figure 4. Nitrogen to potassium ratios for rice after soybeans and rice after rice.

Vegetative plant biomass was slightly greater for rice following soybeans than rice following rice, whereas total seed weight was slightly greater for rice following rice than rice following soybeans. The ratio of vegetation to seed weight was substantially greater for rice following soybeans.

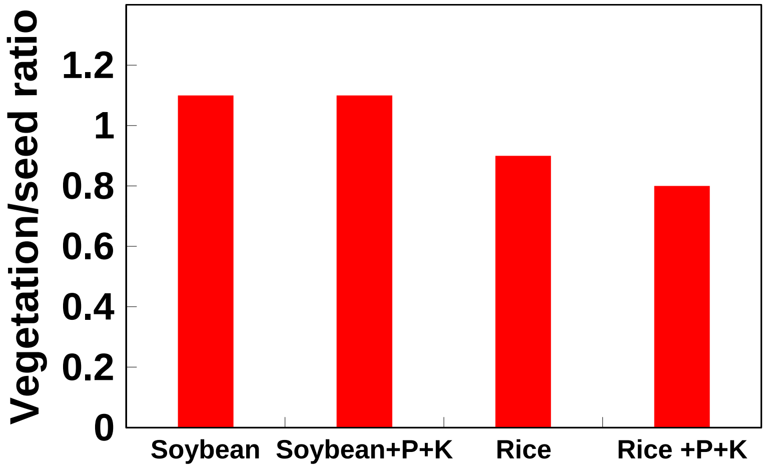


Figure 5. Vegetation weight to seed weight ratios for rice after soybeans and rice after rice.

The total nutrient mass was estimated on a per acre basis, illustrating that the straw residue is an important reservoir for selected plant nutrients (Table 3), especially potassium. Corresponding with the total nutrient uptake on an acre basis, the percent of each nutrient associated with the seed compartment, relative to the total nutrient uptake, is displayed in Table 4. Nitrogen, P, S, Fe, and Cu are preferentially accumulated in the seed and these nutrients are removed from the field during harvest.

Soil Phosphorus Differences

Soil analysis of selected plots demonstrated no significant differences in the Bray1-P soil analysis because of P and K additions.

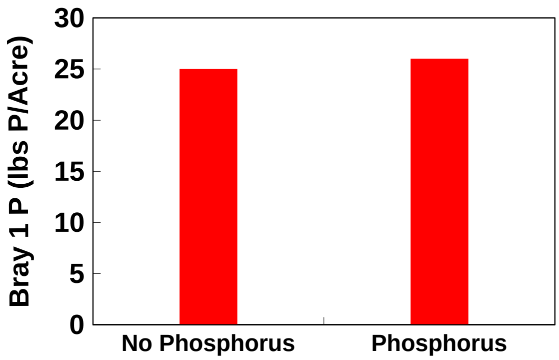


Figure 6. Bray1-P mean values comparing P+K additions.

CONCLUSIONS

The yields of rice were greater after a crop rotation involving continuous rice rather than soybeans. Unfortunately, lodging and seed shattering resulting from strong winds affected the yield results.

Nitrogen rates did not consistently influence rice yields and the low rate of 120 lbs N / acre appears acceptable.

Total nutrient uptake in the vegetation and seed shows how plant essential nutrients are partitioned in the rice plant. Potassium was shown to be substantially partitioned in the rice straw, illustrating the importance of residue decomposition for maintaining soil fertility.

REFERENCES

Havlin, J.L., J.D. Beaton, S.L. Tisdale, and W.L. Nelson. 2005. Soil fertility and fertilizers: An introduction to nutrient management. Prentiss Hall Upper Saddle River, NJ.

Table 1b. Nutrient concentrations prior to internode elongation for rice after rice.

Treatment N	Treatment P		N Percent	S Percent	P Percent	K Percent	Mg Percent	Ca Percent	Na Percent	Fe ppm	Mn ppm	Cu ppm	Zn ppm	B ppm
120	0	mean	3.15	0.16	0.31	2.24	0.19	0.37	0.04	67.75	575.5	3	21.75	6.25
120	0	std	0.56	0.02	0.01	0.2	0.03	0.08	0	4.57	102.58	0.82	2.87	0.5
120	yes	mean	3.05	0.16	0.31	2.26	0.18	0.35	0.04	64.5	575.5	4	21	8.5
120	yes	std	0.3	0.02	0.01	0.21	0.02	0.06	0.01	4.12	86.38	0.82	1.15	3.79
150	0	mean	2.97	0.17	0.3	2.33	0.17	0.35	0.03	131.75	642.5	4.5	21.75	8.25
150	0	std	0.18	0.03	0.03	0.14	0.03	0.05	0	129.53	121.23	1.73	1.5	4.03
150	yes	mean	2.66	0.16	0.31	2.6	0.16	0.33	0.02	71	638.5	4	20.75	8.25
150	yes	std	0.43	0.02	0.03	0.21	0.02	0.03	0.02	2	104.37	0.82	2.5	2.75
180	0	mean	2.54	0.16	0.3	2.32	0.18	0.39	0.03	63.75	706.25	4	20.5	5.75
180	0	std	0.26	0.01	0.02	0.16	0.03	0.06	0.02	4.35	87	0.82	1.73	0.5
180	yes	mean	2.79	0.16	0.32	2.51	0.17	0.37	0.02	68	661.25	3.75	20	5.5
180	yes	std	0.28	0.02	0.03	0.12	0.01	0.05	0	6.78	67.01	0.5	0.82	0.58

Typical values: N (3 to 4%), K(3 to 4%), P(0.25 to 0.30%), Mg(0.1to 0.4%), Ca(0.2 to 1.0%), S(0.25 to 1.0%), Fe(50 to 250 mg/kg=ppm),
Mn(20 to 500 mg/kg), B(10 to 20 mg/kg), Cu(5 to 20 mg/kg) and Zn(25 to 150 mg/kg) after Havlin et al. (2005).

Table 1a. Nutrient concentrations prior to internode elongation for rice after soybeans.

Treatment N	Treatment P		N Percent	S Percent	P Percent	K Percent	Mg Percent	Ca Percent	Na Percent	Fe ppm	Mn ppm	Cu ppm	Zn ppm	B ppm
120	0	mean	3.61	0.25	0.31	0.98	0.32	0.53	0.23	100.5	316.5	10	30.25	8.5
120	0	std	0.21	0.02	0.05	0.16	0.04	0.06	0.06	8.19	61.82	0	1.5	1
120	yes	mean	3.5	0.25	0.31	1.19	0.28	0.5	0.18	95.5	277	9	31	8.25
120	yes	std	0.34	0.01	0.01	0.08	0.03	0.05	0.06	7.94	55.72	0.82	2.94	0.5
150	0	mean	3.89	0.26	0.33	0.99	0.31	0.51	0.18	93.25	297.75	10	32.25	9.25
150	0	std	0.71	0.05	0.04	0.07	0.04	0.04	0.05	5.74	31.97	0.82	8.26	2.5
150	yes	mean	3.75	0.25	0.29	1.18	0.27	0.47	0.14	94.5	299.25	9.75	32.5	8.5
150	yes	std	0.23	0.02	0.09	0.11	0.03	0.07	0.04	13.13	92.61	1.26	3.87	0.58
180	0	mean	3.83	0.24	0.33	0.96	0.29	0.49	0.18	100.5	269	10.5	31	8.25
180	0	std	0.47	0.02	0.09	0.31	0.05	0.05	0.13	11.47	36.25	0.58	4.08	0.5
180	yes	mean	3.69	0.24	0.31	1	0.29	0.5	0.15	95.5	277.5	9.25	29.75	9.5
180	yes	std	0.5	0.01	0.04	0.14	0.04	0.04	0.04	7.19	44.02	1.26	2.06	0.58

Typical values: N (3 to 4%), K(3 to 4%), P(0.25 to 0.30%), Mg(0.1to 0.4%), Ca(0.2 to 1.0%), S(0.25 to 1.0%), Fe(50 to 250 mg/kg=ppm),
Mn(20 to 500 mg/kg), B(10 to 20 mg/kg), Cu(5 to 20 mg/kg) and Zn(25 to 150 mg/kg) after Havlin et al. (2005).

Table 2. Tissue Concentrations at harvest for rice

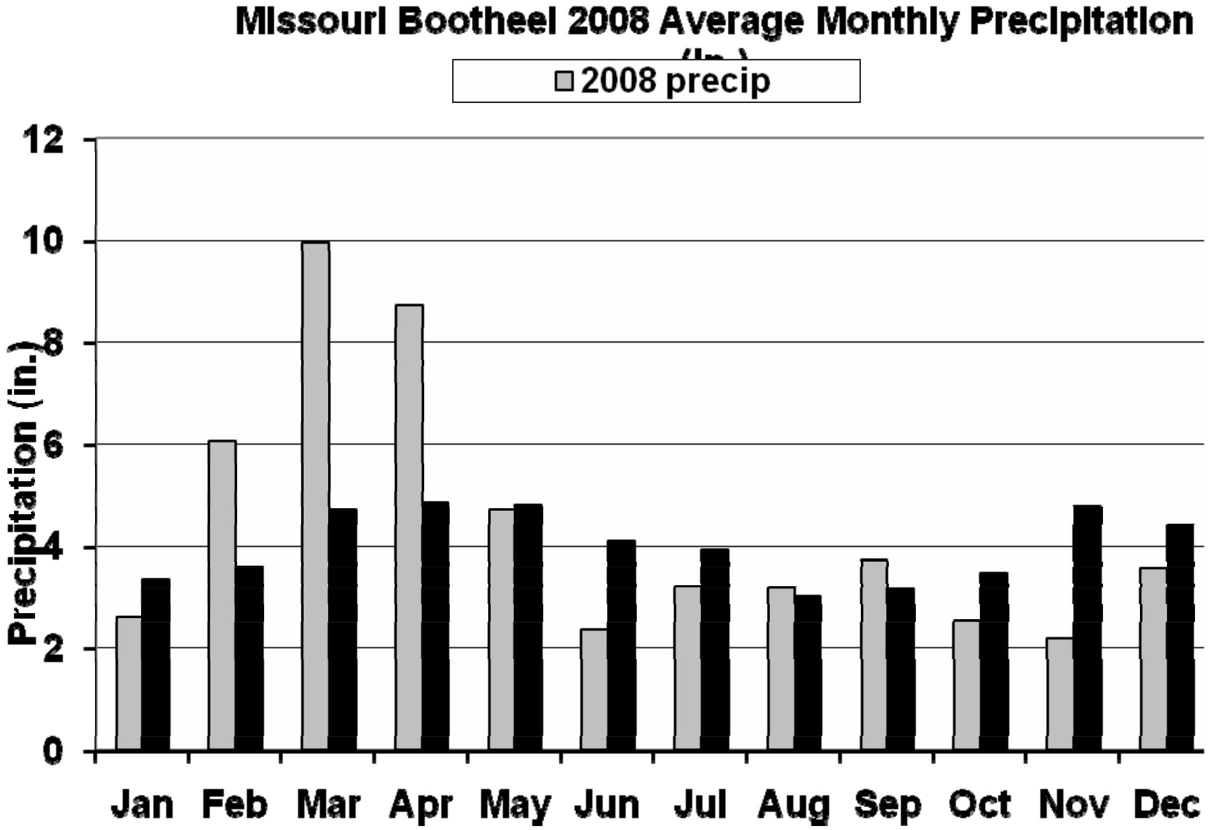
Previous Crop	Plant Part	Treatment	N	P	K	Mg	Ca	S	Na	Fe	Mn	B	Cu	Zn	Biomass
			percent	percent	percent	percent	percent	percent	percent	ppm	ppm	ppm	ppm	ppm	per plant
soy	vegetation	120	0.46	0.16	1.63	0.28	0.25	0.09	0.574	108	506	6	2	59	3.3
		150	0.65	0.18	1.53	0.31	0.28	0.09	0.708	132	647	6	2	60	3.6
		180	0.74	0.18	1.65	0.27	0.25	0.11	0.63	124	542	5	3	64	3.4
		mean	0.62	0.17	1.6	0.29	0.26	0.1	0.64	121.33	565	5.7	2.3	61	3.4
soy	vegetation	120 + PK	1.24	0.24	1.6	0.34	0.31	0.12	0.341	92	515	6	3	52	3.6
		150 + PK	0.86	0.18	1.56	0.27	0.32	0.09	0.495	127	597	5	2	58	3.6
		180 + PK	0.67	0.15	1.44	0.24	0.23	0.08	0.611	123	378	8	2	49	3.7
		mean	0.92	0.19	1.53	0.28	0.29	0.1	0.48	114	497	6.3	2.3	53	3.6
rice	vegetation	120	0.62	0.17	3.44	0.17	0.17	0.1	0.084	103	605	4	1	39	3.2
		150	0.53	0.22	3.09	0.18	0.2	0.09	0.083	126	788	5	1	53	3.1
		180	0.69	0.2	3.06	0.17	0.15	0.09	0.074	122	641	4	1	54	3.7
		mean	0.61	0.2	3.2	0.17	0.17	0.09	0.08	117	678	4.3	1	48.7	3.3
rice	vegetation	150 + PK	0.41	0.24	2.91	0.18	0.21	0.08	0.061	100	845	5	1	55	3.6
		120 + PK	0.63	0.19	2.94	0.21	0.31	0.09	0.041	97	1028	6	2	48	2.6
		180 + PK	0.55	0.23	2.38	0.17	0.18	0.07	0.046	135	765	6	1	56	3.3
		mean	0.53	0.22	2.74	0.19	0.23	0.08	0.05	111	879	5.7	1.3	53	3.2
soy	seed	120	1.35	0.36	0.4	0.14	0.03	0.11	0.002	108	125	5	6	34	3
		150	1.37	0.38	0.41	0.15	0.03	0.11	0.002	105	136	5	8	43	3.4
		180	1.41	0.33	0.41	0.14	0.03	0.11	0.004	110	144	4	5	34	3.3
		mean	1.38	0.36	0.41	0.14	0.03	0.11	0	108	135	4.7	6.3	37	3.2
soy	seed	120 + PK	1.43	0.37	0.41	0.16	0.04	0.11	0.002	391	144	5	7	37	2.9
		150 + PK	1.36	0.3	0.34	0.12	0.03	0.11	0.001	87	126	3	6	34	3.4
		180 + PK	1.4	0.43	0.45	0.18	0.04	0.13	0.002	411	133	4	7	43	3.2
		mean	1.4	0.37	0.4	0.15	0.04	0.12	0	296	134	4	6.7	38	3.2
rice	seed	120	1.31	0.36	0.47	0.16	0.04	0.12	0.001	563	158	7	8	32	3.6
		150	1.23	0.36	0.41	0.13	0.02	0.1	0.001	467	139	2	5	30	3.2
		180	1.38	0.43	0.51	0.17	0.03	0.12	0.001	499	166	3	6	35	4.2
		mean	1.31	0.38	0.46	0.15	0.03	0.11	0	510	154	4	6.3	32.3	3.7
rice	seed	120 + PK	1.31	0.39	0.46	0.15	0.03	0.12	0.001	171	168	3	4	33	4.2
		150 + PK	1.27	0.36	0.42	0.13	0.03	0.11	0.001	151	180	3	4	30	3.9
		180 + PK	1.31	0.33	0.42	0.13	0.03	0.11	0.001	529	177	3	5	32	3
		mean	1.3	0.36	0.43	0.14	0.03	0.11	0	284	175	3	4.3	31.7	3.7

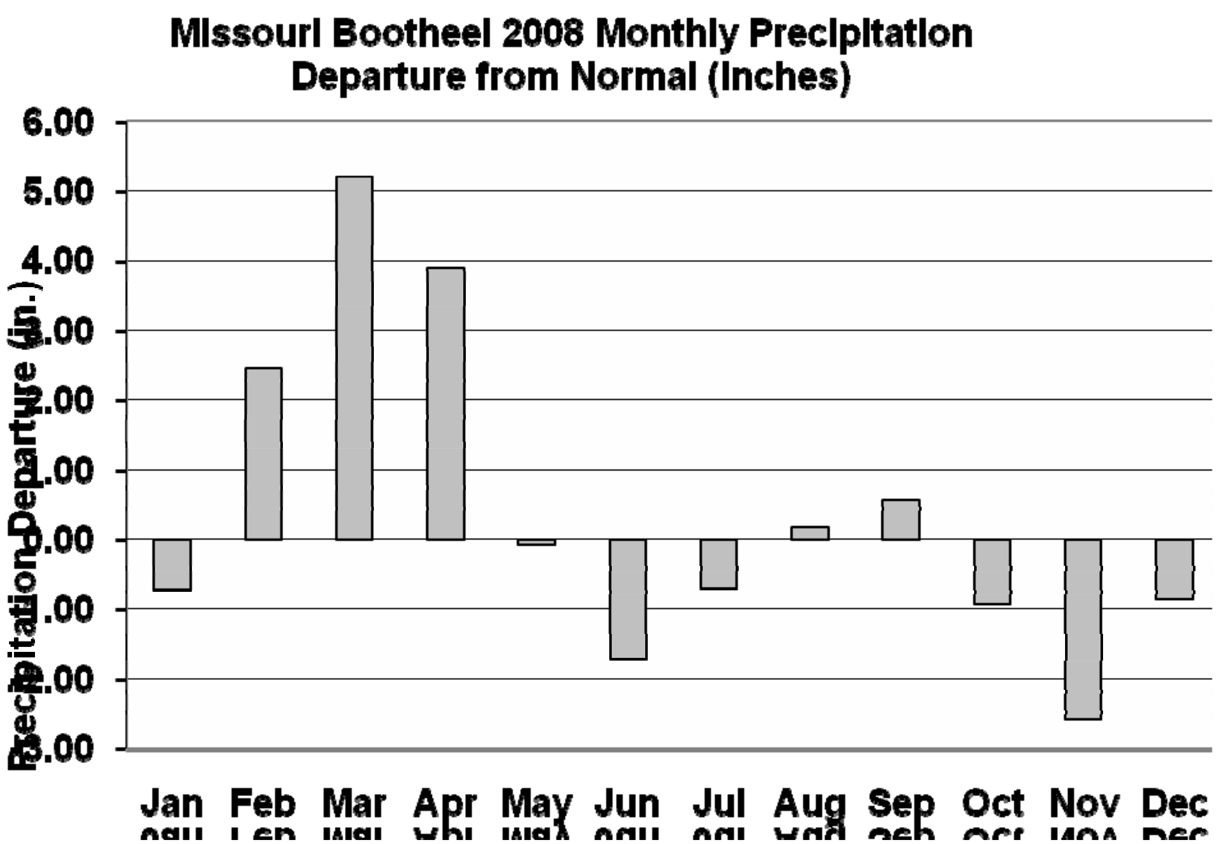
Table 3. Mass of nutrients in living rice crop at harvest.

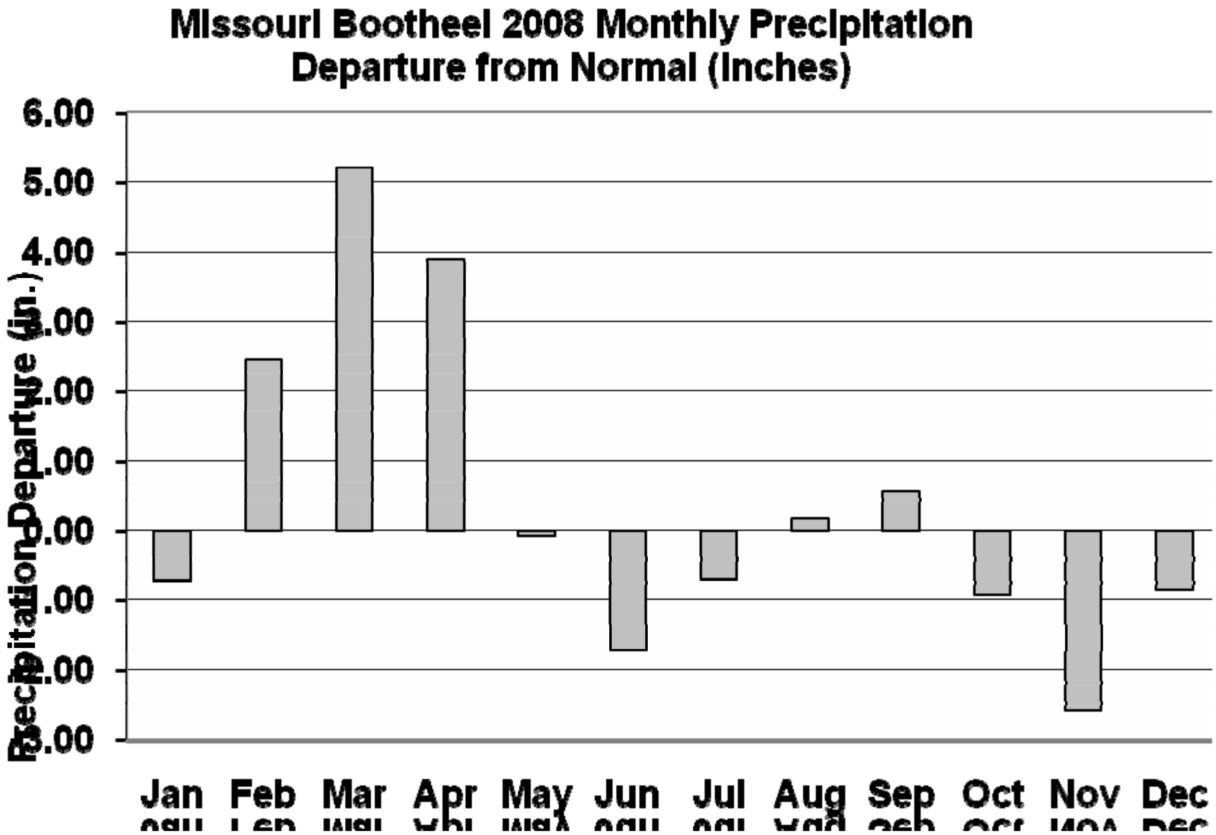
Previous Crop			N	P	K	Mg	Ca	S	Na	Fe	Mn	B	Cu	Zn
			lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac	lbs/ac
soy	vegetation	120	22.31	7.76	79.07	13.58	12.13	4.37	27.84	0.52	2.45	0.03	0.01	0.29
		150	29.12	8.06	68.54	13.89	12.54	4.03	31.72	0.59	2.9	0.03	0.01	0.27
		180	31.56	7.68	70.36	11.51	10.66	4.69	26.86	0.53	2.31	0.02	0.01	0.27
		mean	27.66	7.83	72.66	12.99	11.78	4.36	28.81	0.55	2.55	0.03	0.01	0.28
soy	vegetation	120 + PK	66.48	12.87	85.78	18.23	16.62	6.43	18.28	0.49	2.76	0.03	0.02	0.28
		150 + PK	40.98	8.58	74.34	12.87	15.25	4.29	23.59	0.61	2.85	0.02	0.01	0.28
		180 + PK	38.69	8.66	83.15	13.86	13.28	4.62	35.28	0.71	2.18	0.05	0.01	0.28
		mean	48.72	10.04	81.09	14.99	15.05	5.11	25.72	0.6	2.6	0.03	0.01	0.28
rice	vegetation	120	34.72	9.52	192.66	9.52	9.52	5.6	4.7	0.58	3.39	0.02	0.01	0.22
		150	32.12	13.33	187.29	10.91	12.12	5.45	5.03	0.76	4.78	0.03	0.01	0.32
		180	36.93	10.7	163.77	9.1	8.03	4.82	3.96	0.65	3.43	0.02	0.01	0.29
		mean	34.59	11.18	181.24	9.84	9.89	5.29	4.56	0.66	3.87	0.02	0.01	0.28
rice	vegetation	150 + PK	21.66	12.68	153.75	9.51	11.1	4.23	3.22	0.53	4.46	0.03	0.01	0.29
		120 + PK	25.53	7.7	119.13	8.51	12.56	3.65	1.66	0.39	4.17	0.02	0.01	0.19
		180 + PK	39.48	16.51	170.82	12.2	12.92	5.02	3.3	0.97	5.49	0.04	0.01	0.4
		mean	28.89	12.3	147.9	10.07	12.19	4.3	2.73	0.63	4.71	0.03	0.01	0.29
soy	seed	120	59.54	15.88	17.64	6.17	1.32	4.85	0.09	0.48	0.55	0.02	0.03	0.15
		150	57.95	16.07	17.34	6.35	1.27	4.65	0.08	0.44	0.58	0.02	0.03	0.18
		180	58.37	13.66	16.97	5.8	1.24	4.55	0.17	0.46	0.6	0.02	0.02	0.14
		mean	58.62	15.2	17.32	6.11	1.28	4.68	0.11	0.46	0.58	0.02	0.03	0.16
soy	seed	120 + PK	61.78	15.98	17.71	6.91	1.73	4.75	0.09	1.69	0.62	0.02	0.03	0.16
		150 + PK	61.2	13.5	15.3	5.4	1.35	4.95	0.05	0.39	0.57	0.01	0.03	0.15
		180 + PK	69.93	21.48	22.48	8.99	2	6.49	0.1	2.05	0.66	0.02	0.03	0.21
		mean	64.3	16.99	18.5	7.1	1.69	5.4	0.08	1.38	0.62	0.02	0.03	0.17
rice	seed	120	82.53	22.68	29.61	10.08	2.52	7.56	0.06	3.55	1	0.04	0.05	0.2
		150	76.94	22.52	25.65	8.13	1.25	6.26	0.06	2.92	0.87	0.01	0.03	0.19
		180	83.84	26.12	30.98	10.33	1.82	7.29	0.06	3.03	1.01	0.02	0.04	0.21
		mean	81.1	23.77	28.75	9.51	1.86	7.04	0.06	3.17	0.96	0.02	0.04	0.2
rice	seed	120 + PK	80.76	24.04	28.36	9.25	1.85	7.4	0.06	1.05	1.04	0.02	0.02	0.2
		150 + PK	77.15	21.87	25.52	7.9	1.82	6.68	0.06	0.92	1.09	0.02	0.02	0.18
		180 + PK	85.48	21.53	27.41	8.48	1.96	7.18	0.07	3.45	1.15	0.02	0.03	0.21
		mean	81.13	22.48	27.1	8.54	1.88	7.09	0.06	1.81	1.09	0.02	0.02	0.2

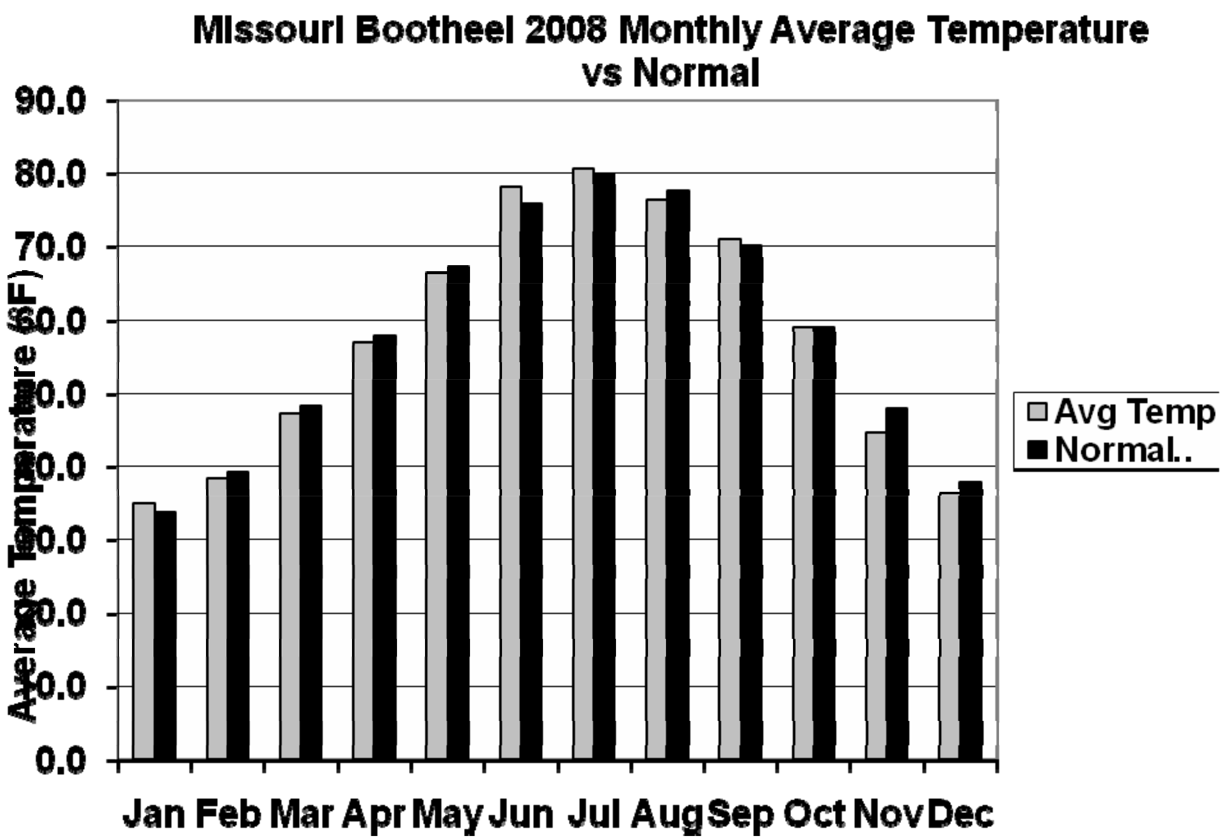
Table 4. Percent of total nutrients in seed.

		N	P	K	Mg	Ca	S	Na	Fe	Mn	B	Cu	Zn
		percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
soy	120	72.7	67.2	18.2	31.2	9.8	52.6	0.3	48	18.3	40	75	34.1
	150	66.6	66.6	20.2	31.4	9.2	53.6	0.3	42.7	16.7	40	75	40
	180	64.9	64	19.4	33.5	10.4	49.2	0.6	46.5	20.6	50	66.7	34.1
	mean	68.1	65.9	19.3	32	9.8	51.8	0.4	45.7	18.5	43.3	72.2	36.1
soy	120 + PK	48.2	55.4	17.1	27.5	9.4	42.5	0.5	77.5	18.3	40	60	36.4
	150 + PK	59.9	61.1	17.1	29.6	8.1	53.6	0.2	39	16.7	33.3	75	34.9
	180 + PK	64.4	71.3	21.3	39.3	13.1	58.4	0.3	74.3	23.2	28.6	75	42.9
	mean	57.5	62.6	18.5	32.1	10.2	51.5	0.3	63.6	19.4	34	70	38.1
rice	120	70.4	70.4	13.3	51.4	20.9	57.4	1.3	86	22.8	66.7	83.3	47.6
	150	70.5	62.8	12	42.7	9.3	53.5	1.2	79.3	15.4	25	75	37.3
	180	69.4	70.9	15.9	53.2	18.5	60.2	1.5	82.3	22.7	50	80	42
	mean	70.1	68	13.7	49.1	16.2	57	1.3	82.5	20.3	47.2	79.4	42.3
rice	120 + PK	78.9	65.5	15.6	49.3	14.3	63.6	1.8	66.5	18.9	40	66.7	40.8
	150 + PK	75.1	74	17.6	48.1	12.7	64.7	3.5	70.2	20.7	50	66.7	48.6
	180 + PK	68.4	56.6	13.8	41	13.2	58.9	2.1	78.1	17.3	33.3	75	34.4
	mean	74.1	65.4	15.7	46.1	13.4	62.4	2.5	71.6	19	41.1	69.5	41.3


Missouri Bootheel 2008 Average Monthly Precipitation
2008 precip
Precipitation (in.)
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Missouri Bootheel 2008 Monthly Precipitation
Departure from Normal (Inches)
Precipitation Departure (in.)
6.00
5.00
4.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Missouri Bootheel 2008 Monthly Precipitation
Departure from Normal (Inches)
Precipitation Departure (in.)
6.00
5.00
4.00
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Missouri Bootheel 2008 Monthly Average Temperature
vs Normal
Average Temperature (°F)
90.0
80.0
70.0
0.0
Avg Temp
Normal..
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Bootheel 2008 Weather Summary
Climate Division 6

Month	Total Precip (in.)	Normal (1971-2000)	Precip. Dept (in.)
Jan	2.61	3.33	-0.72
Feb	6.05	3.59	2.46
Mar	9.94	4.73	5.21
Apr	8.73	4.84	3.89
May	4.72	4.80	-0.08
Jun	2.36	4.08	-1.72
Jul	3.21	3.91	-0.70
Aug	3.19	3.02	0.17
Sep	3.72	3.16	0.56
Oct	2.53	3.46	-0.93
Nov	2.19	4.77	-2.58
Dec	3.57	4.42	-0.85
Ann	**52.82**	**48.11**	**4.71**

Month	Average Temp (°F)	Normal (1971-2000)	Temp Dept. (°F)
Jan	35.0	33.8	1.2
Feb	38.3	39.3	-1.0
Mar	47.2	48.4	-1.2
Apr	57.0	58.0	-1.0
May	66.5	67.4	-0.9
Jun	78.3	76.0	2.3
Jul	80.8	80.1	0.7
Aug	76.6	77.8	-1.2
Sep	71.1	70.3	0.8
Oct	59.0	59.0	0.0
Nov	44.6	48.0	-3.4
Dec	36.5	37.8	-1.3
Ann	**57.6**	**58.0**	**-0.4**