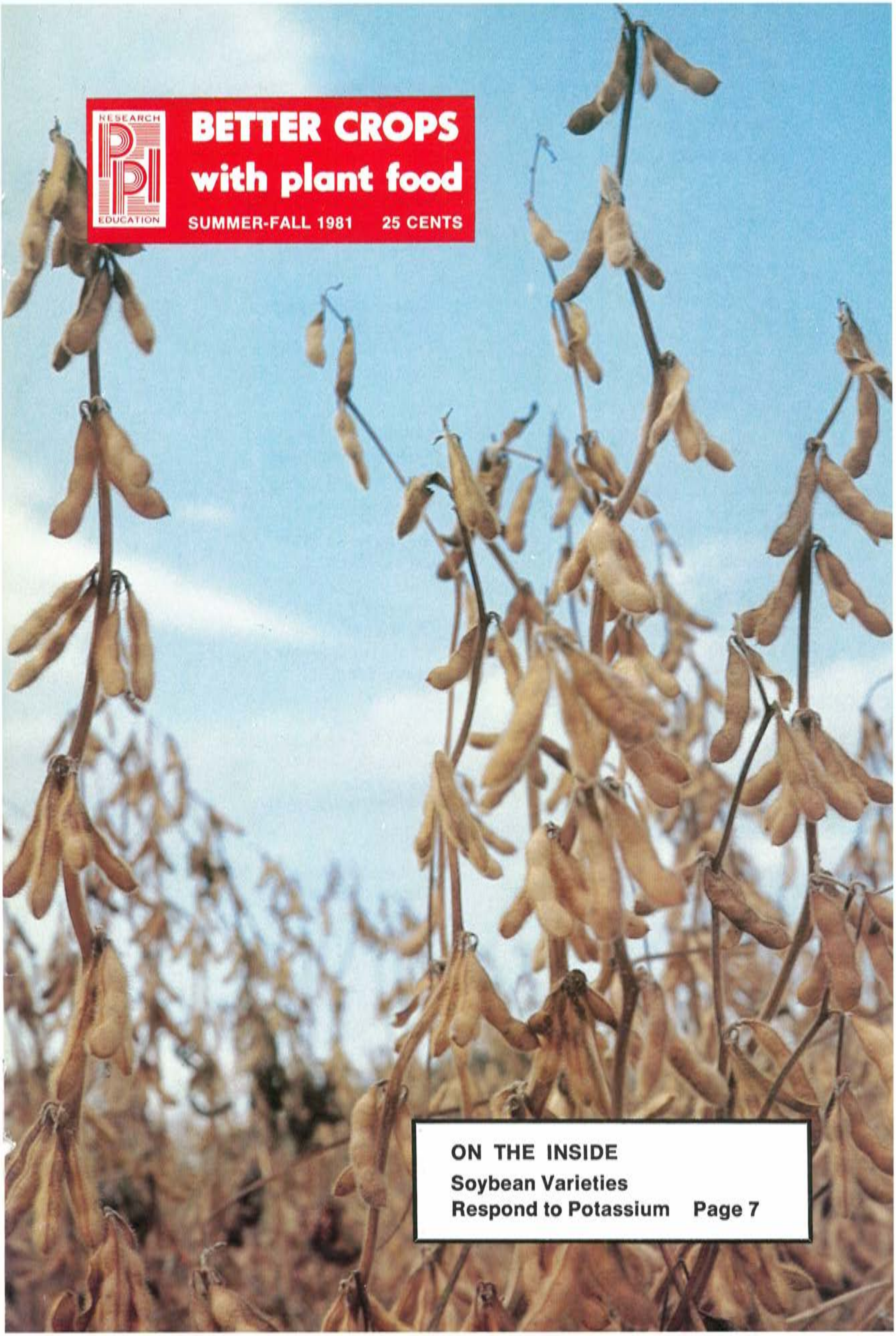
RESEARCH PPI EDUCATION

BETTER CROPS with plant food

SUMMER-FALL 1981 25 CENTS



ON THE INSIDE

BETTER CROPS
with plant food

Editors: Bill Agerton, Don Armstrong, and Santford Martin
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Contents

Conventional Vs. No-Tillage Corn Silage Production

By R. L. Flannery, Rutgers University

NO-TILLAGE SYSTEMS may help farmers produce good corn silage yields with minimum water, minimum wind erosion losses of soil, and maximum use of soil moisture IF winter cover crops are used to protect the land.

A 3-year study compared conventional versus no-tillage systems. We used hairy vetch and rye cover crops and several nitrogen (N) and potassium (K) levels.

Conventional tillage plots were plowed and disked in the usual manner. No-till plots were planted to hairy vetch and rye in the fall, then killed with a contact herbicide just before planting corn. All other cultural practices were the same for good corn silage production.

This phase of the study had four objectives:

1. To determine how much N and K fertilization the two tillage systems needed.
2. To determine the economics of the two tillage systems and the various N and K inputs.
3. To determine how the tillage systems affected soil test levels in the plow zone and at various depths in the plow zone.
4. To determine if corn silage yields would compare for each tillage system at their respective optimum management level.

YIELDS, PRODUCTION COSTS, AND NET RETURNS. Figures 1, 2, and 3 show how N fertilization influenced yield, production costs, and net returns for the four tillage and cover crop combinations at the 180 lb/A K_2O rate.

The 3-year average corn silage yields were essentially the same when grown under conventional and no-tillage systems when adequate N and K were applied.

Conventional treatments consistently yielded more than no-till. But differences were not significant except at N and K_2O levels below 120 lb/A.

Silage corn yields that followed a winter cover crop of hairy vetch without applied N were about equal to those following a winter cover crop of rye that received 180 lb/A of applied N.

The vetch system costs were higher because of seed costs. There was little difference between the costs of the two tillage systems. The highest production cost in the study was $264/A for the vetch-conventional

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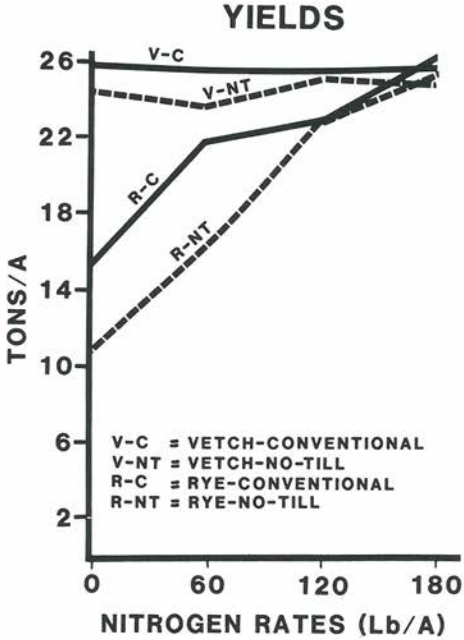

FIGURE 1

system. And this includes a land rental charge of only $30/A. A similar charge was used for all systems.

Net return per acre showed striking variation. Where corn silage values of $16 to $20/ton were used over the three years, returns near or above $200/A were obtained with the best management practices for each system and the resulting **best yields.** Highest returns occurred with the vetch-conventional system at low N levels and high K_2O.

These were followed closely by the vetch-no-till system at the zero N rate. The highest returns in the rye system were obtained at the 180 lb/A nitrogen rate, with conventional tillage slightly more profitable than no-till.

The returns in the rye system fell dramatically with lower N rates. The rye-no-till system was most affected by lack of N. The results in the three figures are shown for the 180 lb/A K_2O rate.

What about lower K_2O levels? Table 1 shows the most profitable treatment in each tillage system. These figures are compared with results when K_2O was reduced by 60 lb/A. The 180 lb/A K_2O was the most profitable in all systems except for rye-conventional, where 120 lb K_2O gave top returns.

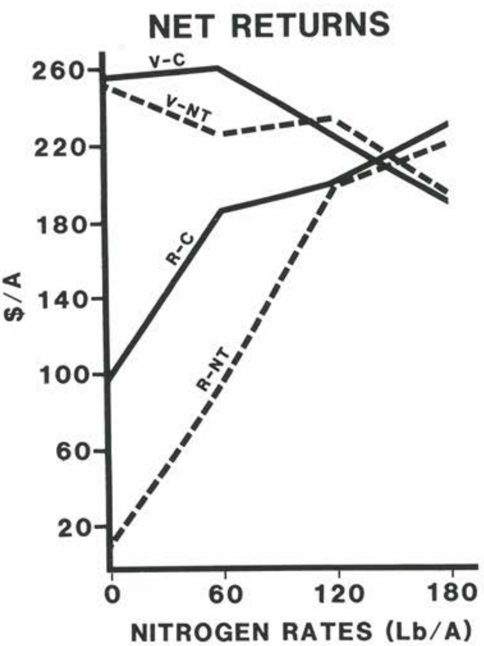

FIGURE 2

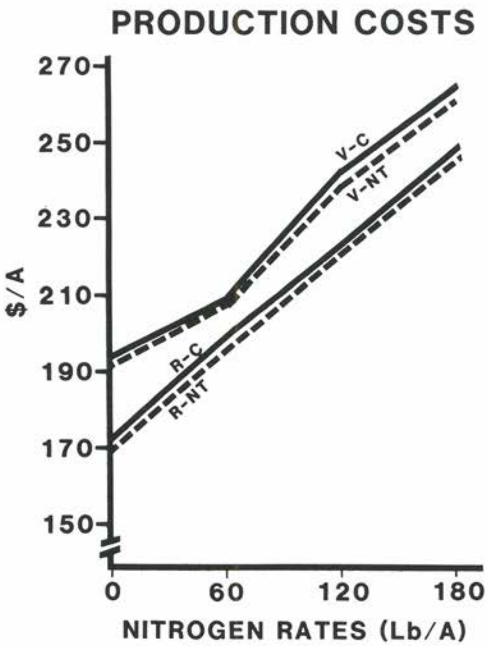

FIGURE 3

This is the only treatment not appearing in **Figure 3**—Net Returns—discussed earlier. Yields were reduced about 1.5 tons/A by a 60 lb/A K_2O reduction in the two conventional tillage systems and about 1 ton/A in the rye-no-tillage system.

Yields and profits were drastically reduced by lower K_2O in the

Table 1. Effect of Potassium on Yield and Return from Four Corn Silage Production Systems

	Nitrogen Level	K_2O Level	Yield	Net Return
	——lb/A——		Tons/A	$/A
Rye-Conventional				
Top Profit Treatment	180	120	25.4	240
Lower K Comparison	180	60	24.0	208
Rye-No-Tillage				
Top Profit Treatment	180	180	25.5	221
Lower K Comparison	180	120	24.4	208
Vetch-Conventional				
Top Profit Treatment	60	180	25.5	260
Lower K Comparison	60	120	23.7	217
Vetch-No-Tillage				
Top Profit Treatment	0	180	24.3	251
Lower K Comparison	0	120	19.9	165

*65% Moisture Silage

vetch-no-tillage system, where 60 lb/A K_2O meant an additional 3.4 tons/A yield and $86/A net return.

This suggests that K management in the vetch-no-tillage system could be a first limiting factor. This needs further investigation.

Table 2 shows K soil test data from the various management systems at low and high N applications.

Table 2. Potassium Soil Test Levels as Affected by Four Corn Silage Management Systems and Nitrogen Fertilization (180 lb/A K_2O Treatment)

	1978 Soil Test K Levels (lb/A)				1975 Soil Test K Levels (lb/A)
	0-2 In.	2-4 In.	4-6 In.	0-8 In.	0-8 In.
Rye-Conventional					
0 N	162	159	209	166	196
180 N	161	140	150	156	169
Rye-No-Tillage					
0 N	320	320	258	253	185
180 N	262	258	188	207	154
Vetch-Conventional					
0 N	126	122	143	158	225
180 N	149	138	143	180	160
Vetch-No-Till					
0 N	302	306	222	278	179
180 N	250	222	144	187	148

Soil K accumulated in the top 4 inches of soil in the no-tillage plots that received 180 lb/A K_2O. This condition was not noted in the conventionally tilled plots.

Although not shown in the table, P also had a tendency to accumulate in the top 4 inches under no-tillage. And soil pH levels in the top 4 inches of soil were decreased as the N rates increased. For example, under both no-tillage systems, the pH at the 2-inch depth was 6.0 with the 60 lb/A N rate and 5.6 at the 180 lb/A N rate.

GENERAL CONCLUSIONS.

1. As with previous experiments with other crops, top corn silage yields were closely associated with highest returns.

2. Hairy vetch can be used successfully in either a conventional or no-tillage system to produce profitable corn silage yields.

3. N fertilization rates are critical and closely associated with yields in the rye-cover crop systems.

4. Vetch can replace from 120-180 lb/A N at the management level practiced for other factors in this study.

5. Balancing K with N is important, regardless of the corn silage management system used. Potassium management appears to be more critical in a vetch-no-tillage system. ■

Soybean Varieties Respond to Potassium

By Charles Graves, Tom McCutchen, Robert Freeland and Robert Hathcock

IN 1975 AT KNOXVILLE, McNair 600 soybeans showed abnormal growth in the seedling stage when grown on an area low in potassium.

The symptoms were stunting in the seedling stage. The leaves were cupped and the margins turned brown.

In some ways, the symptoms resembled potassium deficiency, except the leaves were cupped. To determine whether these symptoms would reappear on McNair 600 or other varieties under low-potassium conditions, a potassium response study was conducted at three locations over a 3-year period.

At Knoxville in 1976, McNair 600, Forrest, and SRF 450 were evaluated on a Sequatchie loam soil at two levels of potassium. In 1977 and 1978, McNair 600, Forrest and Essex were included on the same area.

At Crossville, McNair 600, SRF 450, and York were evaluated each year on a Hartsells loam soil low in potassium.

At Milan, SRF 450, Essex, York, Forrest, and McNair 600 were evaluated on a Collins silt loam soil low in potassium (85 K 1976).

At all three locations, each test area received a uniform application of P_2O_5. The potassium treatments were 0 and 60 lb/A K_2O. The experimental design was a split plot, with potassium being the main treatment and variety the sub-plot. The treatments were replicated four times.

At Martin in 1978, a test was conducted to evaluate soybean variety response to potassium under cyst nematode conditions. The test was conducted on a Grenada silt loam soil which tested high in potassium.

Reportedly under cyst nematode conditions, varieties may need more added potassium than previously thought. Essex, Forrest, and Centennial were evaluated at 0, 40, 80, and 120 lb/A K_2O.

RESULTS AND DISCUSSION. At Knoxville, all varieties gave a small yield response to added potassium in 1976 as shown in **Table 1.**

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Table 1. Soybean varieties evaluated at two levels of potassium at Knoxville from 1976 through 1978.

Year	Rate K_2O	Variety				
		Forrest	Essex	McNair 600	SRF 450	Avg.
	lb/A	Yield bushels per acre				
1976	0	43	—	32	40	38
	60	45	—	33	45	41
					L.S.D. (0.05)	N.S.
	% increase	5	—	3	12	
1977	0	28	31	26	—	28
	60	44	51	36	—	44
					L.S.D. (0.05)	11.4
	% increase	57	65	38	—	
1978	0	22	20	26	—	23
	60	37	47	38	—	41
					L.S.D. (0.05)	4.8
	% increase	39	31	58	—	

And all varieties gave great responses the second (1977) and third years (1978).

At Crossville, SRF 450 produced the highest average yield for a 3-year period shown in **Table 2.** In 1976, McNair 600 and in 1977 York

Table 2. Soybean varieties evaluated at two levels of potassium at Crossville from 1976 through 1978.

Year	Rate K_2O	Variety			
		SRF 450	York	McNair 600	Avg.
	lb/A	Yield bushels per acre			
1976	0	31	23	20	24
	60	35	28	26	30
				L.S.D. (0.05)	1.24
	% increase	13	22	30	
1977	0	25	21	17	21
	60	35	34	25	32
				L.S.D. (0.05)	4.1
	% increase	40	62	47	
1978	0	20	16	16	17
	60	39	26	25	30
				L.S.D. (0.05)	4.8
	% increase	49	38	36	

gave the greatest yield increases from added potassium with SRF 450 producing the greatest response in 1978. The average yield increase was 5 bu/A in 1976, 11 bu/A in 1977, and 13 bu/A in 1978.

At Milan, the yield level for McNair 600 and SRF 450 was low each year as shown in **Table 3.** Essex and Forrest were the two leading varieties in yield.

Table 3. Soybean varieties evaluated at two levels of potassium at Milan from 1976 through 1978.

		Variety					
Year	Rate K_2O	Forrest	Essex	York	McNair 600	SRF 450	Avg.
	lb/A	Yield bushels per acre					
1976	0	32	24	27	20	16	24
	60	37	37	32	23	23	30
						L.S.D. (0.05)	3.1
	% increase	16	54	18	15	44	
1977	0	27	28	23	19	13	22
	60	34	30	29	24	19	27
						L.S.D. (0.05)	4.3
	% increase	26	7	26	26	46	
1978	0	23	26	24	14	18	21
	60	28	30	28	24	18	26
						L.S.D. (0.05)	4.1
	% Increase	18	13	14	42	0	

In contrast to the other two locations, the highest average yield increase was 6.6 bushels per acre in 1976, 5.2 bushels in 1977, and only 4.6 bushels in 1978.

SUMMARY AND CONCLUSION. All varieties tested responded to added potassium on soils low in potassium. At Knoxville, a response was obtained in 1977 and 1978, with no significant response to added potassium in 1976.

Forrest and Essex were the leading yield varieties at Knoxville and Milan with SRF 450 producing the highest yield at Crossville.

Symptoms resembling those seen on McNair 600 in 1975 did not occur at any location. From this study it seems the problem encountered with McNair 600 was not due to low potassium levels. ■

SOIL FERTILITY MANUAL SLIDE SET
PAGE 13

Annual vs. Residual Fertilization for Soybeans

By Tom McCutchen, Supt.
Milan Experiment Station
University of Tennessee

A SOYBEAN FERTILIZATION test was conducted on two soil types in West Tennessee. The purpose was to evaluate the effects of phosphate and potash and their interval of application on soybean yields and subsequent soil test values.

An annual banded application of P and K was compared to large one-time applications that were used to simulate residual applications.

The tests were conducted at the Milan Experiment Station. They were conducted from 1967 to 1972 on a Vicksburg silt loam and from 1968 to 1972 on a Henry silt loam.

Tables 1 and 2 show the initial soil tests that were taken in the fall of 1967. The tables also show soil tests made following harvests in 1968, 1970, and 1972. See page 11.

Tables 3 and 4 show the yields for the study. See page 12.

The annual banded treatment was 40 lb/A each of P_2O_5 and K_2O applied at planting. The residual applications were made as broadcast applications in the spring of 1967 or 1968. The soybeans were grown in 30-inch row spacings. A molybdenum seed treatment was used on all plots.

RESULTS ON VICKSBURG SILT LOAM—SOIL TEST VALUES. Residual applications increased soil test levels of P and K. But by conclusion of the study, the soil test levels had fallen. The check plot K test was reduced from medium (130 lb) to low (98 lb/A).

The 400 lb/A K_2O residual application increased soil test K to a high rating—245 lb. But by the sixth year, the soil tested near low, 125 lb/A. Annual applications appeared to hold soil P and K test values steady during the test period.

YIELDS. The yields responded significantly to fertilization five out of the six years. Differences were between the check and the 400 lb/A residual rates. The response seemed to be from potash.

RESULTS ON HENRY SILT LOAM—SOIL TESTS. Applying P annually increased soil P test levels from a low rating (14 lb/A) to a medium rating (17 lb). Residual P applications increased P soil test rating from low to high, 29 to 85 lb/A. But by the time of the fifth harvest, P soil test values were down to medium levels, 14 to 23 lb/A.

Annual K applications did not build soil K levels. And residual applications did not raise soil K levels to levels that held during the test period. All plots tested low K by the end of the test.

Table 1. Soil test values measured in plots after harvests as influenced by annual applications and residual P_2O_5 and K_2O on Vicksburg silt loam[1]

Fertilizer Treatment lb/A		P - lb/A			K - lb/A		
P_2O_5	K_2O	1968	1970	1972	1968	1970	1972
0	0	16	10	11	150	115	98
40	40[2]	15	11	19	140	120	123
200	0[3]	27	15	15	123	100	95
400	0[3]	38	25	23	120	97	85
0	200[3]	13	11	9	170	117	105
0	400[3]	16	10	11	198	147	115
200	200[3]	31	12	15	185	127	100
400	400[3]	36	24	20	245	160	125

[1] Initial soil test, 1967; pH 6.1, P-15 lb, K-130 lb

[2] Applied in band annually

[3] Applied in single broadcast application in spring 1967 on Vicksburg soil and spring 1968 on Henry soil

Table 2. Soil test values measured in plots after harvests as influenced by annual residual P_2O_5 and K_2O on Henry silt loam[1]

Fertilizer Treatment lb/A		P - lb/A			K - lb/A		
P_2O_5	K_2O	1968	1970	1972	1968	1970	1972
0	0	10	10	10	58	70	53
40	40[2]	11	13	17	85	90	73
200	0[3]	29	21	16	78	80	55
400	0[3]	72	38	21	70	83	58
0	200[3]	11	10	9	115	98	65
0	400[3]	12	10	9	353	115	90
200	200[3]	52	22	14	180	102	60
400	400[3]	85	38	23	330	145	108

[1] Initial soil test, 1968; pH 6.4, P-14 lb, K-60 lb

[2] Applied in band annually

[3] Applied in single broadcast application in spring 1967 on Vicksburg soil and spring 1968 on Henry soil

YIELDS. Fertilization caused definite yield increases. This significant yield increase came from applied K. The annual banded application produced yields greater than those produced by the 200 lb/A residual applications but less than those of the 400 lb residual applications.

CONCLUSIONS. Annual fertilizer applications produced soybean yields greater than those of the 200 lb residual application but less than those of the 400 lb/A rate.

The 400 lb residual application of P_2O_5 and K_2O produced the highest yields. But soil P and K levels provided by this application rate did not

Table 3. Soybean yields as influenced by annual applications and residual P_2O_5 and K_2O on Vicksburg silt loam

Fertilizer treatment		Yield by year bu/A						
P_2O_5	K_2O	1967	1968	1969	1970	1971[3]	1972[4]	6 yr avg
lb/A								
0	0	56.7	35.4	42.0	32.6	23.1	19.5	34.8
40	40[1]	57.2	37.6	39.7	31.5	25.8	23.7	35.9
200	0[2]	55.7	34.4	38.9	32.9	23.6	19.7	34.2
400	0[2]	55.4	36.2	38.8	30.7	23.6	18.8	33.9
0	200[2]	58.1	37.4	44.1	31.8	25.4	23.5	36.7
0	400[2]	58.6	35.4	41.5	35.1	29.7	23.0	37.2
200	200[2]	57.7	37.6	42.8	36.2	25.9	19.9	36.7
400	400[2]	58.7	39.4	39.4	32.8	29.0	27.9	37.8
	$LSD_{.05}$	N.S.	4.3	3.5	3.6	5.3	5.9	
	CV, %	6	8	5	7	14	18	
	Variety	Hood	Hood	Hood	Hood	Hood	Pickett 71	

[1]Applied annually in a band
[2]Applied in single broadcast application in spring 1968
[3]Severe soybean cyst nematode damage
[4]Very dry during growing season and wet during delayed harvests

Table 4. Soybean yields as influenced by annual applications and residual P_2O_5 and K_2O on a Henry silt loam

Fertilizer treatment		Soybean yield, bu/A					
P_2O_5	K_2O	1968	1969	1970	1971	1972[3]	5 yr avg
lb/A							
0	0	13.4	25.6	26.0	25.7	19.5	22.0
40	40[1]	16.1	30.5	32.9	40.7	23.7	28.8
200	0[2]	16.8	26.8	24.8	26.8	19.7	23.0
400	0[2]	16.1	26.6	26.0	31.2	18.8	23.7
0	200[2]	17.5	28.6	30.5	33.2	23.5	26.7
0	400[2]	16.9	31.2	34.6	42.8	23.0	29.7
200	200[2]	16.3	29.7	29.9	32.3	19.9	25.6
400	400[2]	19.2	32.6	32.1	40.3	27.9	30.4
	$LSD_{.05}$	4.5	3.3	2.8	6.6	5.9	
	CV, %	2	7	7	13	18	
	Variety	Hood	Pickett	Pickett	Pickett	Pickett	

[1]Applied annually in a band
[2]Applied in a single broadcast application in spring 1968
[3]Very dry during growing season and wet during delayed harvests

hold their built up levels to completion of the test. When the study ended, P and K soil test values on both soils were falling rapidly, even for the 400 lb/A rate.

P_2O_5 applications increased P soil test values. But applied K did not, except for the 400 lb/A K_2O rate. ■

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Wrap-up for the 1980's

By Lance J. Murrell
Consultant, Idaville, Indiana

ARE WE REALLY HELPING the grower reach his production goal, or are we just selling product? Watch those top farmers migrate toward someone who will help them answer questions about production problems.

IF the fertilizer or chemical dealer can't perform, the farmer will find someone who can. Are we **HELPING** the farmer as much as we say? The farmer gets 75 percent of his information from his dealer. How do we compare?

Do we have something more than a cup of coffee to share with the farmer when he comes to see us?

WILL WE talk about the production inputs we don't sell as much as the ones we sell? Will we talk about corn planter settings to get better in-row plant distribution?

WILL WE talk about the right tillage system for the crop, herbicide, and soil?

WILL WE talk about the best rotation for land use?

WILL WE help the livestock producer plan manure applications to best use fertilizer without overloading and completely unbalancing a soil?

WILL WE talk about proper manure applications even though that manure competes directly with what we sell?

We need to help the grower plan **ALL** his production inputs regardless of whether we sell them.

Are the good farmers moving past us in knowledge? Good farmers are leaving the dealer behind in crop production knowledge, equipment use, variety selection, chemical choice, and incorporation techniques.

If we can't keep ahead, we ought to at least keep even.

ARE WE DOING field diagnosis in the summer for all our customers? Or are we reserving that for just a precious few growers we see all the time?

It's more fun to work with some farmers. Some growers require more help than others. But all are important to our business. And all would like to see us during the growing season when problems develop.

ARE WE REALLY USING all our power of observation to know what's going on around us? Can we **HELP** our customers make decisions?

No university will ever have enough people, time, and money to do all the research we would like to have done.

IT'S UP TO US! It's up to each of us to be **KEENLY** aware of what's going on. Let's not come down to December and find another growing season gone with our not knowing what went on.

Are we setting production goals for 1985 with our customers? If we have no goal, we have no plan. If we have no plan, we have no real future. We just exist.

The fertilizer and chemical business that will **BE HERE** five years from now is one that will muster every ounce of knowledge and experience it has to help all its customers reach their production goals. This challenge lies before us all. ■

Effect of K on Juice Quality and Yield of Sugarcane

By Laron E. Golden
Louisiana State University

THE EFFECT OF POTASSIUM on juice quality (sucrose and purity) and the yield of early maturing sugarcane varieties (first and second stubble crops) was studied at 10 locations in Louisiana in a 4-year study.

Five early maturing varieties were used. These were CP48-103, L60-25, L62-96, L65-69 and CP65-357. The soil types were those on which applied fertilizer K normally increased sugarcane yields.

Nitrogen fertilizer was applied at a 160 lb or 240 lb/A rate. Potassium fertilizer was applied at 80 lb/A K_2O. Samples for juice quality determinations were taken in early October and late November. Yields were measured after the November juice quality sampling.

Table 1 lists locations, varieties, and soil types where the tests were conducted. Extractable K at the location was measured at medium low to low levels. **Table 2** shows the effect of potassium fertilizer on sucrose content and purity of juice samples and on yield of the sugarcane.

Table 1. Locations, varieties and soil types on which field K tests were conducted during 1972-75.

Location Number	Plantation	Year	Variety	Class (age) or Cane	Soil type
1	Johnson	1972	L62-96	First stubble	Commerce sil
2	Johnson	1973	L62-96	Second stubble	Commerce sil
3	Evan Hall	1974	CP48-103	First stubble	Commerce sil
4	Columbia	1974	CP48-103	First stubble	Commerce sil
5	Oaklawn	1974	L60-25	First stubble	Baldwin sil - Iberia c
6	Oaklawn	1974	L62-96	First stubble	Baldwin sil - Iberia c
7	Oaklawn	1974	L65-69	First stubble	Baldwin sil - Iberia c
8	Evan Hall	1975	CP48-103	First stubble	Commerce sil
9	Columbia	1975	CP48-103	Second stubble	Commerce sil
10	McLeod	1975	CP65-357	First stubble	Commerce sil

Increases from K were relatively consistent. Statistically all increases over the check were highly significant.

Table 2. The effect of fertilizer K on sucrose content and purity of normal juice and on yield of sugarcane and sugar from stubble cane of early-maturing varieties.

Lcn. No.	First sampling				At harvest							
	Sucrose		Purity		Sucrose		Purity		Yield: Cane		Yield: Sugar	
	Check	K	Check	K	Check	K	Check	K	Check	K	Check	K
	%								Net tons/A		lb/A	
1	11.54	11.84	76.72	77.45	14.46	14.89	82.20	82.46	32.51	32.10	6739	6889
2	11.87	12.64	77.99	80.23	14.49	14.82	83.36	84.18	28.47	28.77	5912	6141
3	10.62	11.21	73.35	75.12	12.59	12.90	78.63	80.70	27.86	29.97	4980	5419
4	11.76	12.19	73.74	75.28	12.98	13.45	79.87	81.48	32.93	34.06	6006	6495
5	12.86	13.02	74.11	75.46	14.14	14.94	79.53	81.55	37.09	42.49	7666	9153
6	12.36	13.48	67.55	73.59	15.02	15.30	79.02	80.14	33.01	35.29	7280	7878
7	10.94	11.42	61.74	62.99	14.89	15.09	77.01	77.52	40.36	40.94	8610	8898
8	10.87	11.81	76.43	79.31	13.43	13.61	81.27	81.74	29.37	30.16	5578	5845
9	11.59	11.91	74.45	75.62	14.79	14.89	83.97	84.40	28.60	31.78	6090	6823
10	10.71	11.35	73.38	75.37	14.29	14.50	80.73	81.31	29.37	31.96	6005	6693
Avg.	11.51	12.09	72.95	75.04	14.12	14.44	80.55	81.55	31.96	33.75	6478	7024
Inc. over Ck.	—	0.58	—	2.09	—	0.32	—	1.00	—	1.79	—	546
LSD 0.01	—	0.24	—	0.86	—	0.18	—	0.57	—	1.08	—	265

In normal juice at the first sampling, potassium application caused an average of 0.58 percent increase in sucrose and an average 2.09 percent increase in purity.

The average increase in sugar per net ton of cane was 9.9 lb. Or the increase over check was 6.3 percent.

Average net cane yields in early October were estimated by considering actual yields obtained at harvest in late November. Based on net cane and on sucrose and purity data, the increase in sugar yield due to K was 592 lb/A at the first sampling. Of this, 280 lb was due to increase in net tons of cane and 312 lb to improvement in juice quality.

In normal juice at harvest, the increase in sucrose was 0.32 percent and the increase in purity was 1 percent. The increase in sugar equaled 5.4 lb per net ton of cane or 2.7 percent.

Average increase in yield due to potassium was 1.79 net tons of cane and 546 lb of sugar per acre, respectively.

The increase in net tons of cane from the early maturing varieties studied was about equal to that obtained with K in a large number of Louisiana tests with stubble cane of the older, and generally medium to late maturing, commercial varieties.

The effect of the 0.32 percent increase in sucrose and 1 percent increase in purity at harvest equaled 187 lb sugar per acre. Of the 546 lb increase in sugar, 359 lb were due to increase in net tons of cane and 187 lb to increase in sucrose and purity.

The data presented show the total increase in sugar yield coming from application of potassium fertilizer to the early maturing varieties studied was generally constant throughout October and November. But the portion of the increase attributable to improvement in juice quality was greater early in the harvest season. ■

See Easy-Order Coupon Page 13

Coastal Bermudagrass Responds to Phosphorus and Potassium in East Texas

By C. D. Welch and J. Neal Pratt
Texas A&M University

COASTAL BERMUDAGRASS is a major forage crop in east Texas. It is a deep-rooted, drought-tolerant, high-yielding forage suited for pasture or hay.

Of the 2,000,000 acres grown in Texas, 30 to 40 percent is harvested for hay. Many soils in the area are naturally low in native P and K. As Coastal continually removes P and K, many soils are rapidly being depleted of their reserves. Some are already deficient in one or both nutrients.

Soil fertility research was conducted on Coastal bermudagrass at the Texas A&M Agricultural Research and Extension Center at Overton between 1970 and 1976. **Figure 1** shows the results. These data show the response to P increased during the first four years, even when no K was applied.

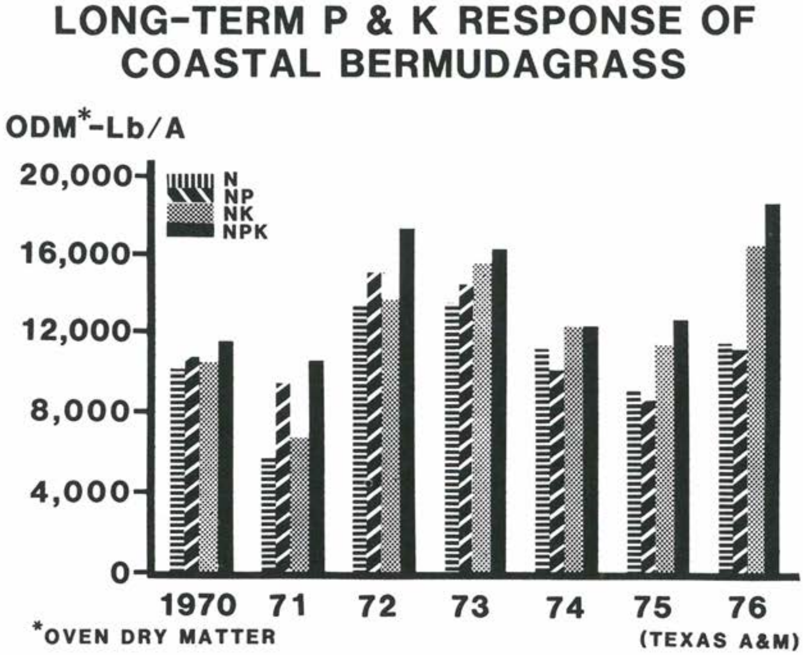

FIGURE 1

But during years five through seven, yield levels for the NP treatment were no better than the plots where only nitrogen was applied. N rates were 300 lb/A or more depending on rainfall.

The same data show an increase in response to K from the first to the seventh year. Even though the response was not significant the first year, it was statistically significant after the fifth year. By 1975, helminthosporium had invaded the no K plots, stunted growth, and reduced yields.

Further study at Overton showed rhizome production greatly reduced when no K was applied. This reduced the rate of recovery from winter dormancy, leading to reduced stands. **Table 1** shows the results.

Table 1. Visual stand ratings and rhizome production of coastal bermudagrass influenced by K_2O rates

K_2O Rate lb/A	Visual Stand Ratings (%)		Rhizomes Produced, lb/A	
	Spring*	Late Summer**	Spring*	Fall*
0	43	17	1,073	112
120	73	59	1,797	172
240	69	88	1,938	1,540
LSD_{05}	11	9	680	898

*Darco soil **Cuthbert soil

(Keisling-Texas A&M Agr. Research & Extension Center, Overton)

As potash rates were increased from 0 to 240 lb/A K_2O, visual stand ratings increased from 43 to 69 percent in the spring and from 17 to 88 percent in late summer. Rhizome production increased from 1,073 to 1,938 lb/A in the spring and from 112 to 1,540 lb/A in the fall.

Similar work done in Arkansas showed that spring cover was significantly increased by K across several N treatments.

DEMONSTRATIONS ESTABLISHED. Based on the above developments, four demonstrations were initiated in 1976 in East Texas. One location was discontinued after 1977 because the cooperator suffered an accident. Two additional locations were added in 1978 and 1979.

Table 2 shows summary results of the demonstrations.

The first N increment, along with P and K, was applied in early spring with an additional 100 lb/A after each cutting. Half the K was applied

Table 2. Average coastal bermudagrass hay yields from P and K demonstrations in east Texas, 1976-1979.

Treatment lb/A $N-P_2O_5-K_2O$	Hay Produced, lb/A					
	Site 1	Site 2	Site 3	Site 4*	Site 5*	Average
300-0-0	8,515	7,513	6,506	5,866	9,751	7,630
300-100-0	11,260	11,577	8,314	5,839	9,254	9,231
300-0-300	11,347	11,853	9,242	11,411	11,892	11,149
300-100-300	14,123	15,027	10,348	13,122	12,148	12,954
300-100-300***	15,042	14,508	9,773	13,364	12,172	12,972

*For 1978 and 1979 only
**In some cases, N rates were as high as 400 lb/A
***Split—half in spring and half after second cutting

after the second cutting in one treatment to determine if split applications would increase response to K.

Treatments were repeated each year on the same plots. Plots were about one acre in size. Hay was baled and counted for each treatment. Where possible, the period between harvests was 30 days or less.

RESPONSE TO P. The response to P was not consistent among years or locations. There was no rate variable. So the only determination was whether a yield response was obtained.

The greatest response to P occurred during the first years. This should be expected since soils tested low in P. The average response to P across the five locations and four years was 1,601 lb/A.

RESPONSE TO K. As with P, the response to K was not consistent among years or locations. Although there were inconsistencies, the K response was greatest during the last years. The average response to K across the five locations and four years was 3,519 lb/A.

PK INTERACTION. Table 3 shows the percentage response to P, K and P plus K. In these demonstrations, there was a strong interaction between P and K. An interaction occurs when the response of one or more factors is modified by the effect of one or more other factors. The interaction may be positive or negative.

Table 3. Percentage response to P, K, and P plus K above N alone

Treatment	Percent Increase Above N Alone
N	—
NP	21.0
NK	46.1
NPK	69.8

Interactions do not have to occur between or among fertilizer nutrients. In fact, there will be interactions with any combination of management practices, such as grazing patterns and fertility, stocking rates and rotation, etc.

The point is this: Balanced management systems where everything is done right and on time will lead to higher yields. And part of this production will have been the results of positive interactions.

SOIL PK RESERVES. How far should soil K be "drawn down" and at what level should the K be maintained? The soil test level should be kept at least in the medium range for potassium and phosphorus.

This means you should apply at least the P and K removal rates. That is about 12 to 15 lb P_2O_5 and 30 to 40 lb K_2O per ton of dry forage.

Where high N rates are used to increase production, apply some P and K at the high soil test. Soils should be tested often enough to monitor P and K and hold them at the desired level.

Subsoil K is a vital consideration. Evaluate it in developing long-range fertilization programs. It seems clear that each farmer should collect enough subsoil samples to know if his soils are generally low or high in K.

When the K rate was split into two applications, no advantage over single applications resulted. But, the 300 lb/A K_2O rate may have been above the break in response. So, the initial application may have provided adequate K for the yields produced. ■

Hairy Vetch Vs. Rye Cover Crops For Corn Silage Production Using No-Till

By R. L. Flannery, Rutgers University

A THREE-YEAR CORN SILAGE STUDY conducted on Freehold sandy loam soil showed that a hairy vetch cover crop was beneficial to a succeeding corn silage crop without adding extra nitrogen. The project was conducted at the Research Center in Adelphia, N. J.

One phase of the experiment used several nitrogen rates (ammonium nitrate) and potassium (KCl) to compare hairy vetch versus rye cover crops in a no-tillage system.

Each year corn was planted in 30-inch rows with a final population of 23,200 plants per acre. One lime application was applied uniformly over the entire area at the rate of 1,000 lb/A total oxides (CaO and MgO) in the spring of 1976. All other cultural practices were uniform for good corn silage production.

The major objectives for this phase of the study were:

1. To determine the optimum nitrogen and potassium fertilization requirements with the two cover crop systems.
2. To determine the relative contribution a winter hairy vetch cover crop would make toward supplying total nitrogen needs.
3. To determine the economics of the two cover crop systems and the various nitrogen and potassium inputs.
4. To determine the influence of the variables on nutrient content of the corn crop at tasseling and harvest stages.
5. To determine the influence of these cultural practices on soil test levels over time.

SOIL TEST RESULTS. Table 1 shows the beginning and ending soil test values at an 8-inch depth for selected treatments.

YIELD AND ECONOMICS. Table 2 shows the 3-year average yields, net return, and production costs per ton for selected N and K treatments for corn silage grown following rye or vetch as the no-till cover crop.

Top yields with the rye system were obtained with 180 lb of both N and K_2O. A net return of $221/A and production costs of $9.61 per ton were the most favorable at this fertility level.

Table 1. Soil Test Results For Selected Treatments

	1975				1978			
	pH	P	K	Mg	pH	P	K	Mg
	Vetch Cover Crop							
N Rates at 180 lb/A K_2O								
0	6.3	76	179	341	6.1	75	241	275
60	6.2	73	153	348	6.1	80	201	318
120	6.2	67	147	405	6.2	70	202	251
180	6.0	74	148	337	5.9	73	162	239
N Rates at 180 lb/A N*								
0	6.0	73	75	288	5.9	76	84	203
60	6.0	65	78	317	5.8	61	77	218
120	6.0	73	131	421	5.8	59	142	217
180	6.0	74	148	337	5.9	73	162	239
	Rye Cover Crop							
N Rates at 180 lb/A K_2O								
0	6.0	82	185	329	6.1	77	190	254
60	6.0	82	186	349	6.3	75	251	234
120	6.1	76	144	375	6.1	67	181	262
180	5.8	72	155	224	6.0	72	203	202
K Rates at 180 lb/A N*								
0	5.9	75	83	244	5.9	74	69	196
60	5.8	78	92	302	5.9	70	79	214
120	5.8	86	152	352	6.1	73	147	250
180	5.8	72	154	224	6.0	72	203	202

*Potassium levels were established on plots receiving variable K rates from a previous experiment.

Table 2. Corn Silage Yields, Net Return and Production Costs/Ton with Various Selected Management Systems (1976-78).

Fertilizer Treatment		Yields (65% M.)		Net Returns		Production Costs Per Ton*	
N	K_2O	Rye	Vetch	Rye	Vetch	Rye	Vetch
lb/A		Tons/A		$/A		$/Ton	
0	0	10.1	19.0	17	180	14.46	8.74
180	0	21.6	21.3	174	150	10.19	11.17
180	60	23.3	22.7	196	168	9.75	10.83
180	120	24.4	24.2	208	186	9.75	10.53
0	180	10.8	24.3	11	251	15.65	7.90
60	180	16.3	23.7	92	225	11.96	8.78
120	180	22.9	25.0	198	234	9.65	9.56
180	180	25.5	24.9	221	192	9.61	10.56

*Silage values used were $16, $14, and $14/A respectively for yields under 15 tons for the three years and $20, $18 and $18/ton respectively for yields over 15 tons/A.

Cost figures involved vary from year to year and on crop cultural practices employed. The average annual costs ranged from $146 to $241 per acre over the three years.

The vetch system's top yield was with 120 lb/A N and 180 lb/A K_2O. But the highest return of $251 per acre and the lowest production cost of $7.90 per ton occurred at the zero nitrogen and 180 lb/A K_2O rate. And these were the best in the no-tillage plots.

If adequate potassium is available, corn silage following a winter cover crop of hairy vetch without applied nitrogen will yield about the same amount of silage as corn following winter rye receiving 120 to 180 lb/A nitrogen.

NUTRIENT CONTENT AND REMOVAL. Samples for nutrient analysis were taken from the ear leaf at silking and from the silage crop at harvest in 1978.

Table 3 shows the effect of N and K_2O rates on the percent N and K in the plant at these two growth stages. Nitrogen rates at the highest K_2O rate increased the percent N at ear leaf stage.

Table 3. Percent N and K in Corn at Two Growth Stages

	Percent N				Percent K			
	Ear Leaf		Silage (grain & stover)		Ear Leaf		Silage (grain & stover)	
	Rye	Vetch	Rye	Vetch	Rye	Vetch	Rye	Vetch
N Rates at 180 lb/A K_2O								
0	2.5	3.0	1.2	1.5	2.25	2.70	1.20	0.93
60	2.7	2.9	1.1	1.4	2.20	2.18	1.05	0.88
120	3.0	3.2	1.1	1.4	2.15	2.20	0.90	0.85
180	3.3	3.5	1.3	1.4	2.33	1.95	1.00	0.90
K_2O Rates at 180 lb/A N								
0	3.6	3.5	1.3	1.5	1.15	0.78	0.80	0.58
60	3.4	3.2	1.3	1.5	1.83	1.15	0.73	0.63
120	3.4	3.3	1.2	1.2	1.95	2.00	0.78	0.83
180	3.3	3.5	1.3	1.4	2.33	1.95	1.00	0.90

The N content of both growth stages was higher in the vetch. This reflects the contribution of N from this winter legume. Nitrogen rates influenced K content little when this nutrient was applied. But there was a tendency to reduce K with added N. The depressing effect on K content was widest at the ear leaf stage with a vetch cover crop.

Potassium fertilization at the 180 lb/A nitrogen level influenced N content little under either system. Potassium fertilization increased the K content under all systems.

Very low K values were obtained at silking with a zero K_2O rate in the rye system and at the zero and 60 lb rates in the vetch system.

Table 4 shows nutrient removal and yields in 1978 for combinations of the highest and lowest N and K rates with the two cover crops. Vetch removed the most nitrogen regardless of the fertilizer treatment.

Table 4. Nutrient Removal From Selected Fertilizer Treatments

Treatment		Corn Silage Yields	N	P_2O_5	K_2O	Ca	Mg
lb/A		Tons/A	lb/A				
0-N	**0-K_2O**						
	Rye	12.6	106	73	90	25	19
	Vetch	20.2	191	76	110	41	41
180-N	**0-K_2O**						
	Rye	24.7	225	80	166	64	45
	Vetch	23.0	242	66	112	56	53
0-N	**180-K_2O**						
	Rye	13.4	113	87	136	23	17
	Vetch	26.8	272	112	209	53	36
180-N	**180-K_2O**						
	Rye	30.3	276	108	254	70	40
	Vetch	30.7	290	98	233	62	37

This is especially striking at the 180 lb/A N and zero K_2O rates where corn silage yields with rye yielded over 1.5 tons more than vetch. But the N removal was less.

The reverse is true for potassium. At the top rate for both N and K_2O, the vetch system produced yields slightly higher than rye. But K_2O removal was less.

Data in **Tables 3 and 4** suggest nitrogen in the rye system and potassium in the vetch system may have been one of the first limiting factors to higher yields and profits.

This experiment shows hairy vetch can be grown successfully in New Jersey as a winter cover crop for biologically fixing atmospheric nitrogen for succeeding corn crop. This knowledge could help growers during periods in which nitrogen supplies are inadequate or prices abnormally high. ■

On a Very High PK Soil

Plowdown P and K with N Payoff in a Drought Year

By Ivan Wikner*
Pioneer Hi-Bred International, Inc.

DELAYED SILKING often occurs with drought before and during corn pollination. Low water availability usually gets the blame.

But the real limitation may be low NPK uptake and nutrient balance within the plant due to dry topsoil before pollination.

Recent research tests checked phosphorus (P) and potassium (K) levels at the Pioneer Breeding Station in central Iowa. The data suggest a re-evaluation of high soil test levels and corn response in dry years.

The research plots have been in corn for at least 30 years. High rates of NPK have been applied annually for corn breeding and research management tests. This high fertility pattern raised a question about feasibility of continued high phosphate and potash rates.

So in 1980 the 100 lb/A P_2O_5 and 120 lb/A K_2O rates were omitted from some plots. They will receive N rates alone for a period of five years to see if soil test levels and yields decline. The other area will receive the usual N rates plus the phosphate and potash treatment.

The 1981 research data are included in this article to show the difference for the two years.

Soil Test Results

Before the tests began, soil tests were taken in fall 1979 to determine fertility level build-up. The 1980 soil test was from the area where no additional P or K was added. Both the P and K tests were very high as shown in **Table 1.** The 1981 tests were taken in the fall from both the check and PK treatment areas.

Although there's some variability in the first soil tests, the levels appear quite uniform for this loam-texture soil.

Weather pattern

A serious drought developed during 1980 in central Iowa after corn emerged. The plots were planted April 26 and the corn emerged on May 7. Plots were planted heavy and thinned to 22,000 plants per acre.

*Mr. Wikner is Manager of the Agronomy Service Department, Central Division, Pioneer Hi-Bred International, Inc., Johnston, Iowa.

Table 1. Soil test results*

	1979 (Fall)	1980 (Fall)	1981 Check	1981 PK
	lb/A			
P_1	320(VH)	348(VH)	306(VH)	322(VH)
K	822(VH)	780(VH)	750(VH)	676(VH)
Mg	426(VH)	412(VH)	214(VH)	312(VH)
Na	—	14(VL)	20	22
Ca	3,180(H)	2,660(H)	2,250(M)	2,700(M)
NO_3	—	56(H)	18(L)	12(L)
S	14(L)	12(L)	16(L)	12(L)
Zn	15.2(VH)	9.6(H)	5.0(M)	8.2(H)
Mn	28(H)	16(L)	16(L)	10(L)
Fe	112(VH)	114(VH)	138(VH)	144(H)
Cu	1.8(M)	1.2(L)	1.0(L)	1.2(L)
B	2.0(M)	1.8(M)	1.6(L)	1.8(L)
Organic Matter	3%	2.9%	2.1%	2.8%
Soil pH	6.6	6.4	6.1	6.5
Buffer pH	6.9	6.9	6.8	6.8
C.E.C.**	11.5 meq	10.3 meq	8.8 meq	9.8 meq

*From A & L Lab **C.E.C. = Cation Exchange Capacity

At pollination in 1980 dramatic differences were showing up between the N alone and NPK treatments. Barrenness was the main component affected. It drastically reduced the grain per plant where N was applied without P and K. Notice the number of days above 90 degrees F in **Table 2.** Most were during the pollination period.

Table 2. Weather records, Johnston, IA

Weather Period	Rainfall (inches) 1980	Rainfall (inches) 1981	Growing Degree Days Accumulated 1980	Growing Degree Days Accumulated 1981	Days Above 90° (1980)	Days Above 100° (1980)
April	0.88	1.76	107	304		
May	3.47	2.13	562	718		
June 1-10	3.05		653			
11-20	0.92		836			
21-30	0.50		1,068	1,349	4	
	4.47	4.32				
July 1-10	0.32		1,323	—	7	4
11-20	0.31		1,604	—	10	5
21-31	0.54		1,858	2,099	6	1
	1.17	4.46				
August	5.60	7.06	2,577	2,770		
Total	15.59	19.73			27	10

In 1981, May was somewhat dry. But overall temperatures were more moderate and rainfall was well distributed.

Results

A randomized split-split-plot experimental design was used with 4 replications and 4 hybrids. The plots were harvested with a research combine. The analysis of variance is shown for the 1980 experiment with the levels of significance for the treatments and their interactions. A PR>0.001 means that 999 times out of 1,000 the differences observed will be due to the treatment and not chance.

Figure 1 shows the average yields of the four hybrids in 1980 as influenced by N, PK and NPK combinations. On this very high P and K soil, applying 200 lb/A of **N alone decreased** the yield by 20 bu/A. **When the N was applied with the PK treatment the response was 91 bu/A more than N alone.**

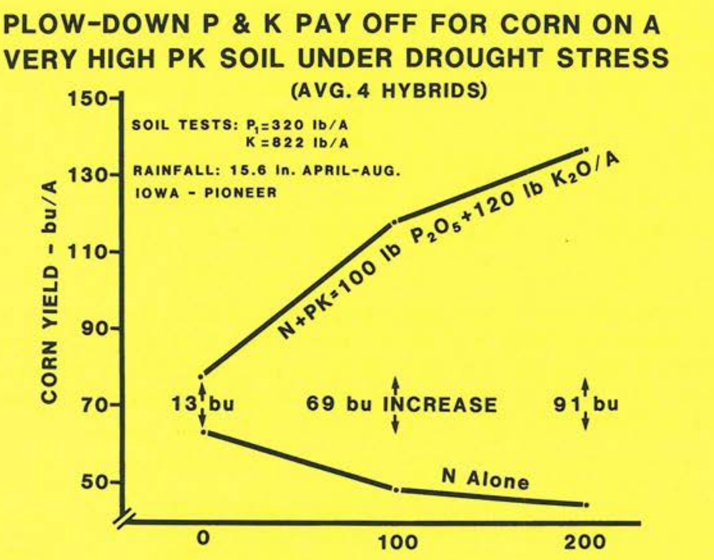

FIGURE 1

The PK treatment alone increased yields 13 bu/A. The interaction between the N and PK was 78 bu/A.

Here's another way to look at the data. In **Figure 2,** note the effect of the N, PK and NPK combinations on moisture use efficiency of the 15.6 inches rainfall that occurred in 1980.

The N alone decreased the bushels per inch of rainfall from 4.17 to 2.89 bu/inch. The PK treatment alone increased the efficiency to 5 bu/inch. But when the combination of N and PK was applied the efficiency increased to 8.72 bu/inch. That's an increase of 4.55 bu/inch over the unfertilized soil.

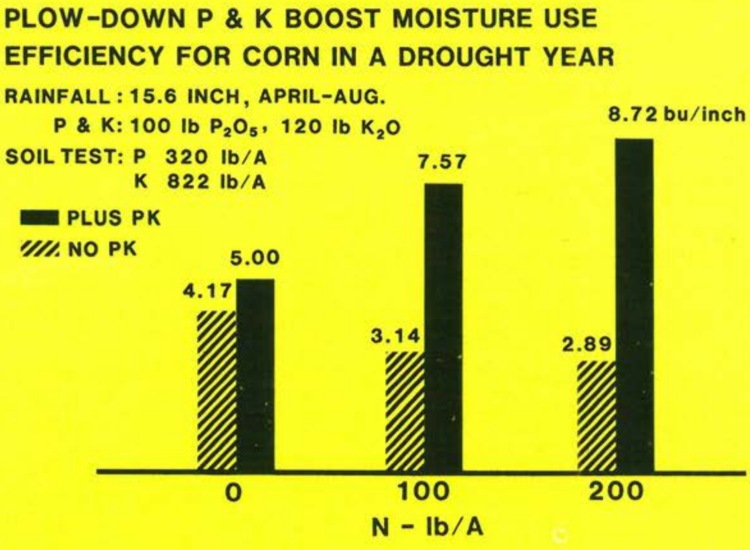

FIGURE 2

N and PK treatments produced a positive interaction for moisture use efficiency of 5.01 bu/inch. The increased moisture effectiveness is striking.

Under good conditions, moisture use efficiency can be 10 bu/inch of soil moisture. Under excellent conditions, it will reach 13 bu/inch.

1981 Results

Average 1981 yields of the four hybrids on check plots was 174 bu/A. Nitrogen alone did not increase yields. The PK treatment showed a positive response of only 10 bu/A with the 200 lb/A N rate. This produced a top yield of 183 bu/A. The treatment differences were not significant in statistical analysis.

Considering April-August rainfall, the water use efficiency of the check treatment would be 8.82 bu/inch. That's somewhat higher than the 4.17 bu/inch of the 1980 check.

Water use efficiency of the top NPK treatment was 9.28 bu/inch of rainfall, while the previous year it was 8.72 bu/inch.

Plant Analysis

There was no plant analysis in 1980, but leaf samples were taken in 1981. The data indicate that N concentrations were low, though there was no apparent response to applied N.

Sulfur values were as low as 0.116%. Zinc concentrations were as low as 7 ppm for one hybrid and treatment. Copper values were as low as 3 ppm, and boron as low as 4.33 ppm.

Some of these leaf analyses follow indications from soil analysis data. There may be adjustments in applications of sulfur, zinc, copper, and boron. This would test effects of the PK treatments and interaction with N rates over time.

This soil might have a much greater yield potential in a year with good rainfall.

DISCUSSION OF RESULTS

Because 1980 was the first of a 5-year study, the results should be evaluated in relation to previous data from stress experiments. But the data were highly significant. And drought problems face some areas every year. These results might stimulate observations of silk delay and barrenness that corn growers may be up against.

There was a surprise in the 1980 results. The very high soil test levels of phosphorus and potassium did not supply enough P and K to balance the effect of added N.

Either the soil P and K were not readily available due to dry soil conditions or the reversion to non-available forms was greater than expected. The annual P and K that produced these significant yield increases was plowed down in the fall. So the fertilizer was placed in an ideal position for nutrient uptake during early growth. This produced significant yield increases and greatly improved moisture use efficiency.

The study identifies silking and silk delay as a critical factor closely associated with NPK balance, barrenness and yield. It also supports the importance of early NPK uptake and balance in the plant prior to tasseling and silking.

Fertility studies seldom look at genetic differences in uptake and response of different elements. One of the goals of this study was to obtain data on different hybrids and their response to different fertility levels.

The hybrids were all fuller season maturity, but with different genetic composition. The analysis of variance N × PK × hybrid, N × hybrid and PK × hybrid interactions indicated that all the hybrids were reacting in a similar way to the fertility and drought conditions.

Table 3. Analysis of variance

Source	Anova SS	F value	PF > F
Rep	20730.95	36.74	0.001
PK	80270.63	426.82	0.001
Rep x PK	1069.18	1.90	0.167
N	1943.82	15.80	0.001
Rep x N	4003.95	3.55	0.017
PK x N	25785.38	68.55	0.001
Rep x PK x N	3945.85	3.50	0.013
Hybrids	3773.18	6.69	0.003
Rep x hybrids	1933.25	1.14	0.385
PK x hybrids	1548.09	2.74	0.074
Rep x PK x hybrids	1686.21	1.00	0.477
N x hybrids	703.55	0.62	0.710
Rep x N x hybrids	3400.43	1.00	0.496
PK x N x hybrids	2888.38	2.56	0.057

Future fertility experiments in drought areas need to study methods of application to obtain greater nutrient uptake before pollination and during kernel fill. Some of the criticism of barrenness and low yields during drought may be related to poor uptake and use of N, P and K prior to silking.

Possibly, deeper placement or banding for early growth may provide enough N, P and K to obtain adequate silking. This placement feature, along with stronger silking hybrids, could be a real bonus for more consistent yields in droughty areas or years.

The 1981 data indicate how different years can be. Responses to applied nutrients were certainly not profitable. However, soil test and plant analysis data point to adjustments in the fertility program needed to evaluate the benefits of the N and PK treatment combinations. For example, nitrogen applications perhaps should be split.

The results also indicate good yields can be obtained when nutrients, as reflected by plant analysis, are below adequate levels. The yield potential needs to be explored, when the concentrations are all at levels considered optimum. ■

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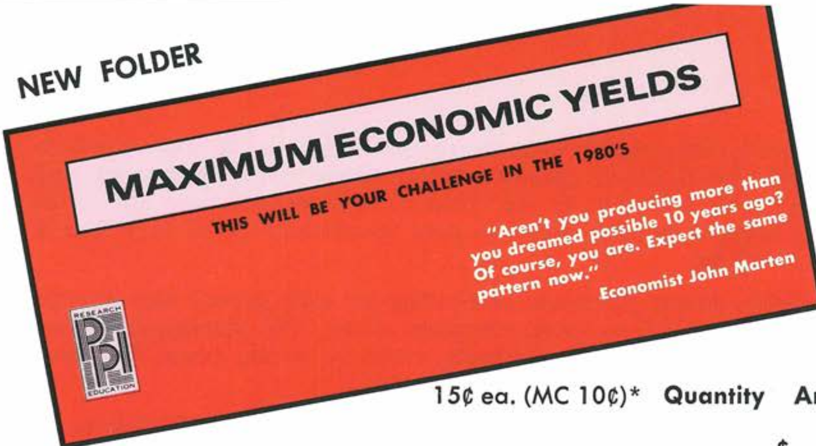

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