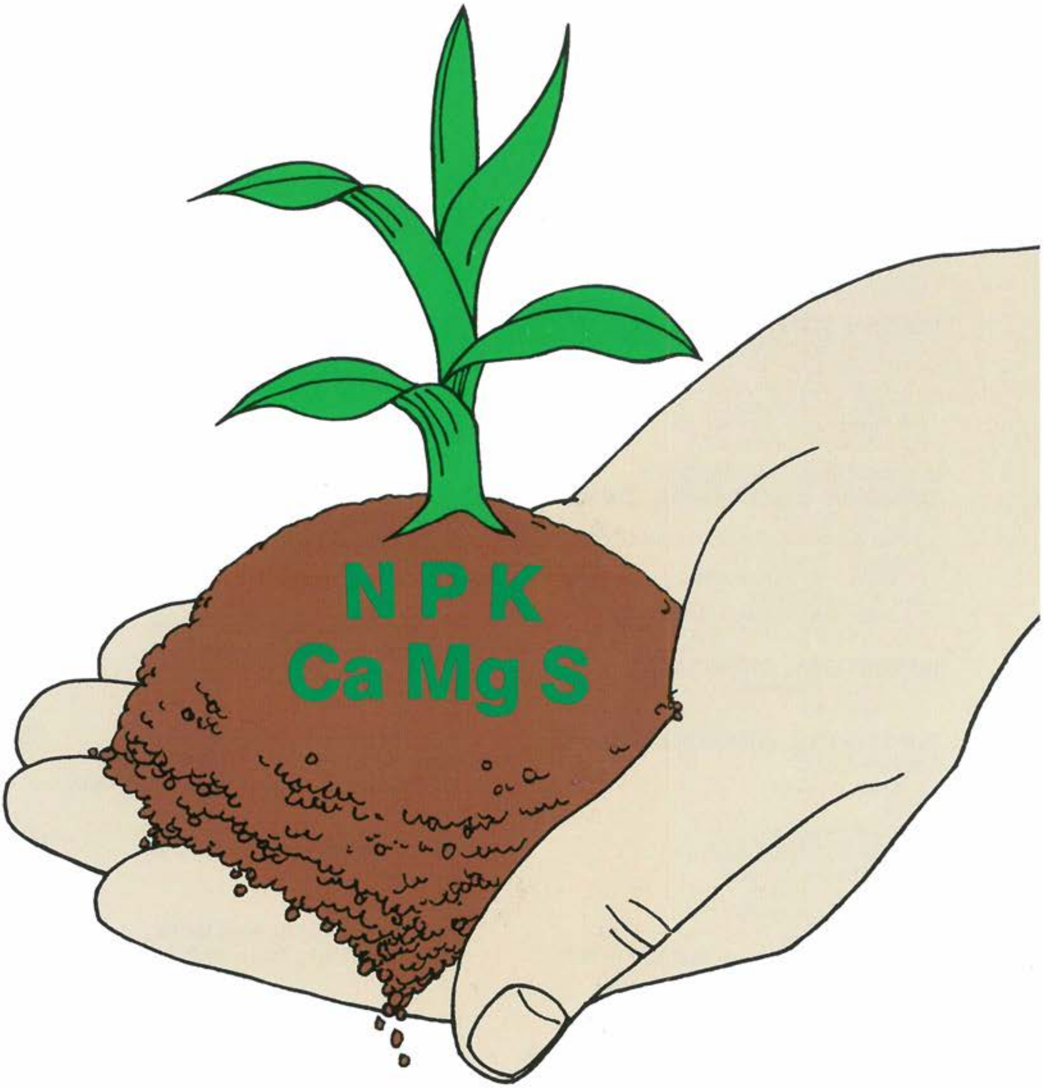
RESEARCH PPI EDUCATION

BETTER CROPS with plant food

Fall 1986



Give crops a helping hand - Know nutrient uptake needs for Maximum Economic Yields

BETTER CROPS with plant food

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Contents

Farmers Not Satisfying Alfalfa's Appetite for P and K

Alfalfa researcher M.B. Tesar encourages alfalfa growers to look at the economics of proper fertilization for higher, more profitable yields.

FARMERS in many areas of North America are losing profits by overlooking the P and K needs of alfalfa, according to Dr. M.B. Tesar of Michigan State University. Dr. Tesar is a leading alfalfa researcher and currently holds the world record of an average of 10 tons per acre for a two-year period on nonirrigated alfalfa grown in replicated research.

Guidelines for producing alfalfa, developed by Dr. Tesar, describe the management needed by farmers to successfully achieve high yields. The guidelines reflect his research showing that once a good alfalfa stand is established on well-drained land, fertilizer management becomes the key factor in achieving maximum economic yields.

"Farmers should be looking for low-risk, high-return investments in today's economy," says Dr. Tesar. "Potash has consistently improved alfalfa yields and profits in research at Michigan State and at other Midwest and Eastern universities."

Alfalfa's large appetite for P and K explains why fertilizer management is so important. Each ton of alfalfa hay removes about 15 lb of phosphate (P_2O_5) and 60 lb of potash (K_2O) from the soil. "A five-ton crop removes almost 300 lb of K_2O per acre," explains Dr. Tesar. "Most farmers do not apply enough potash to replace crop removal even at average yields of 3.5 tons per acre."

The researcher believes most alfalfa fields could benefit from additional potash fertilization. "For example, the 13 million acres of alfalfa grown east of the Missouri River receive an average of less than 100 lb/A of K_2O annually. If the rate were increased to 200 lb/A (333 lb/A of 0-0-60) yields would probably increase one-half ton per acre," he notes.

Management decisions affecting profits are especially important to farmers now. Dr. Tesar says that "the economics of fertilizing alfalfa look very good at today's prices. Profits could be improved on most alfalfa fields \$20 to \$30 per acre with an additional 100 pounds of K_2O per acre. This assumes a potash cost of 10 cents per pound of K_2O and that the extra half-ton of yield is worth \$40 (\$80 per ton)."

Alfalfa can be topdressed with potash in the spring or fall, according to Dr. Tesar. "Alfalfa not fertilized in fall or early spring can be topdressed after the first cutting. Our research has shown no benefit to splitting potash applications when the total amount applied is 400 pounds of K_2O or less. We have also shown no disadvantage to potassium chloride (0-0-60) as the potash source at these and higher rates. It is the most commonly used material and generally the least expensive."

Dr. Tesar encourages alfalfa growers to be diligent in seeking higher yields because their per ton production costs decline. Fertilizer management becomes increasingly important as alfalfa yields climb.

"Farmers who have the soils and management abilities to achieve alfalfa yields in the six to eight ton range should be applying 400 lb of K_2O per acre annually on most soils, especially those that test low to medium in K. Our work shows that K_2O rates up to 400 lb/A (667 lb of 0-0-60) are economic on soils testing low to medium in K," he concludes. ■

Plant Food Uptake in a Maximum Yield Corn Study

By Roy L. Flannery

Plant food uptake analysis was part of a maximum yield research effort in New Jersey. This article reports nutrient uptake required for a 308 bu/A research yield.

GROWING crops in maximum yield research requires precision management. Nothing should be left to chance. That is the approach we used to obtain a 6-year average corn yield of 307 bu/A.

To achieve high yield goals, it is essential to establish the potential through seeding management techniques which assure a vigorous, uniform stand at the right population and with the right genetic material. It's equally important to closely monitor crop needs throughout the growing season.

One of the prime factors in attaining consistently high yields was the application of adequate and balanced amounts of plant nutrients. We know that as yields increase, so do the nutrient demands of the crop.

To develop a better understanding of nutrient needs of high yielding corn, the final year of the test was devoted to measuring dry matter accumulation, nutrient uptake and distribution within the plant. Samples were collected at eight growth periods to obtain dry matter and nutrient content data. The corn grain yield in this year was 308 bu/A and total dry matter (DM) accumulation was 28,332 lb/A.

Table 1 gives the DM accumulation and nutrient uptake for each of the growth periods sampled.

The percent potassium (K) in DM always exceeded nitrogen (N); the uptake figures in **Table 1** reflect this high K demand. The highest percent K (5.78%) in the tissue was at the 8-leaf stage, 44 days after emergence. These data suggest that for high corn yields the plant takes up about 1.12 lb N, 0.45 lb P_2O_5 and 1.29 lb K_2O for every bushel of expected yield.

Figure 1 and **Table 2** depict the accumulation of the three major nutrients over the growing season. There is a tremendous nutrient demand during the period of greatest vegetative growth. About 65% of the N, 41% of the P, and 78% of the K is taken up by early tassel.

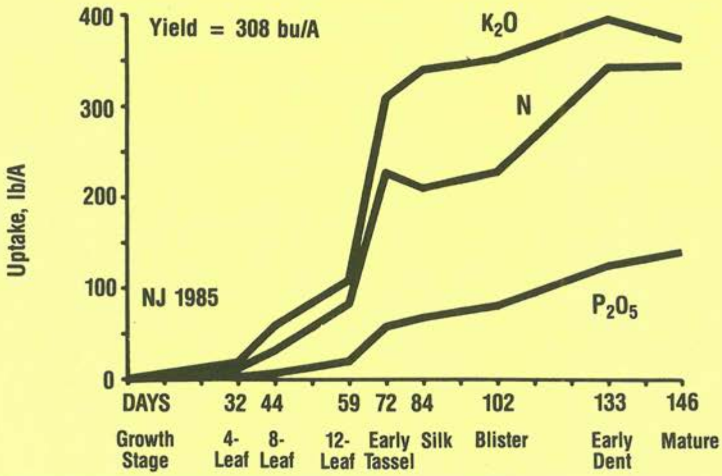
Table 1. Pounds of dry matter (DM) and nutrients absorbed per acre by corn at various growth stages.

Growth Stage	4 leaf	8 leaf	12 leaf	Early tassel	Silk	Blister	Early Dent	Mature
Days	32	44	59	72	84	102	133	146
	lb/A							
Dry Matter	282	847	2,996	9,317	12,654	16,373	27,026	28,332
N	12	32	83	227	210	228	343	345
P_2O_5	3	7	20	58	68	81	125	140
K_2O	19	59	109	309	340	352	396	374
Ca	1	4	14	35	41	45	51	53
Mg	1	2	6	17	20	26	38	39
S	0.6	2	5	13	15	19	33	36

Micronutrient uptake (ppm)	Mn	Fe	Cu	B	Zn
At Maturity	238	509	27	29	124

Dr. Flannery is Professor of Soils and Crops, Cook College, Rutgers University, New Jersey. After achieving consistently high corn yields in six years of maximum yield research, he is now working with field-scale demonstration fields to help implement management practices.

Figure 1. Nutrient uptake over the growing season for corn.



Two hundred pounds of K_2O, over 50% of the total, was taken up in a 2-week span from the 12-leaf stage to early tassel. During this 13-day period of rapid vegetative growth, the nutrient uptake was approximately **11 lb N, 3 lb P_2O_5, and 15 lb K_2O per day.**

Potassium was available to the plant in this test through high soil tests (426 lb/A), a preplant application of 250 lb K_2O/A (40% derived from cow manure and 60% from potassium sulfate), plus 4 applications of 50 lb each through the irrigation system. Providing adequate K both for the heavy demand during vegetative growth and during grain development, when K is essential to help transport food products, appears to be one of the keys to high yield corn production.

A higher percentage of the total N and P_2O_5 needs was taken up during grain development compared to K as indicated by the slope of the lines in **Figure 1.**

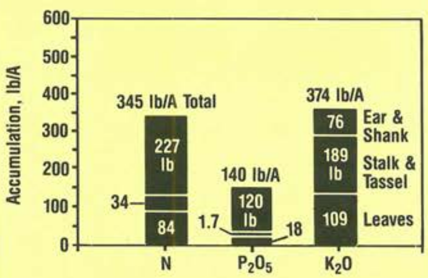
Figure 2 helps to explain this later season demand. Note the large amount of N and P in the ear and shank. These two nutrients must be available and are transported in large amounts to the grain sink during grain development.

Total P_2O_5 uptake of 140 lb was achieved through high soil tests (251 lb/A), a preplant application of 150 lb/A (two-thirds derived from cow manure and one-third from normal superphosphate), plus four applications of P_2O_5 totaling 150 lb through the irrigation system. ■

Table 2. Nutrient uptake per day by growth periods in corn.

Sampling Stage	Days in Period	Nutrient Uptake Per Day (lb) N	P_2O_5	K_2O
4-Leaf	32	.38	.08	.58
8-Leaf	12	1.63	.35	3.35
12-Leaf	15	3.43	.90	3.37
Early Tassel	13	11.05	2.85	15.32
Silk	12	-1.43	.88	2.63
Blister	18	1.00	.70	.68
Early Dent	31	3.71	1.44	1.41
Mature	13	0.16	1.16	-1.65

Figure 2. Nutrient accumulation in corn plant parts at maturity.



Plant Food Uptake in a Maximum Yield Soybean Study

By Roy L. Flannery

Nutrient uptake for a 101 bu/A soybean research yield is reported in this article.

MAXIMUM yield soybean research was conducted in rotation with the corn test. Like corn, a management philosophy was used prior to and at seeding to establish a high soybean yield potential. Then the crop was monitored closely throughout the growing season for management needs to achieve this potential.

We obtained a 6-year average of 103 bu/A from our optimum treatments. Close attention was given to the nutritional requirements of soybeans throughout the growing season. The final year of the test (1985) nutrient uptake was determined at several growth periods and the yield achieved that year was 101 bu/A. **Table 1** gives the dry matter accumulation and nutrient uptake for each of the growth periods sampled.

The data suggest that nutrient uptake for soybean yields in the range produced in these studies would be approximately: 5.5 lb N, 1.31 lb P_2O_5, and 4.29 lb K_2O for every bushel of expected yield.

Nutrient Uptake Over the Growing Season

Figure 1 shows the accumulation of the three major nutrients over the growing season. From emergence to full bloom, soybeans take up about 30 to 35% of the N, P, and K requirements. This percentage of nutrient uptake during the vegetative growth period is much lower than was observed in corn. The loss of nutrients in the final 16 days reflect the loss of leaves prior to maturity.

The period of greatest K uptake ocurred immediately after full bloom and during pod development. The greatest demand for N and P occurred during the next 3-week period when seed development within the pod takes place.

Table 1. Dry matter accumulation and nutrients absorbed per acre by soybeans at various growth stages.

Growth Stage	(2) Three Tri-leaf	(3) Six Tri-leaf	(5) Full Bloom	(7) Pod Dev'lp	(9) Soft Green	(10) Mature
Days	40	51	67	82	103	119
Dry Matter	lb/A					
	784	1,585	4,757	9,495	16,900	16,594
N	30	46	171	308	548	494
P_2O_5	6	12	40	74	132	112
K_2O	27	57	149	293	433	397
Ca	11	20	49	101	152	165
Mg	4	8	20	34	55	56
S	2	3	11	20	32	28
Near Maturity		Micronutrient uptake (lb/A)				
		Mn	Fe	Cu	B	Zn
		1.03	6.32	0.12	0.08	0.74

Research was on a Freehold sandy loam soil testing very high in P and K, with pH 6.0-6.5. Total nutrient applications were: 150 N; 200 P_2O_5; and 300 K_2O lb/A, applied preplant and 2 fertigations.

Dr. Flannery is Professor of Soils and Crops, Cook College, Rutgers University, New Jersey.

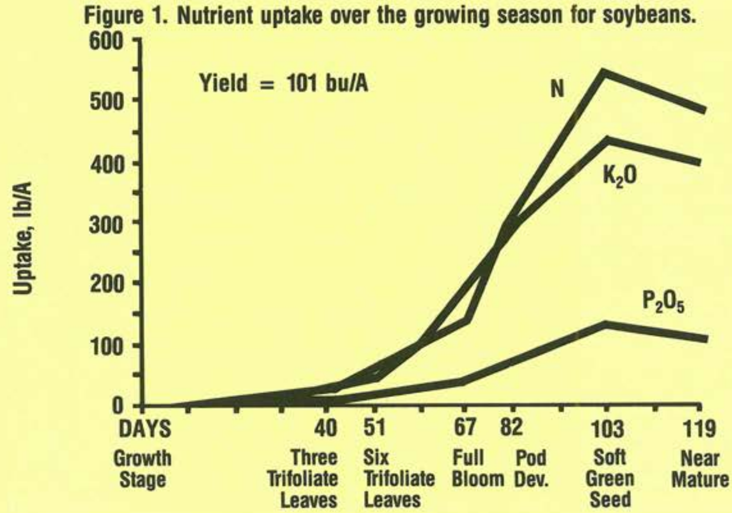


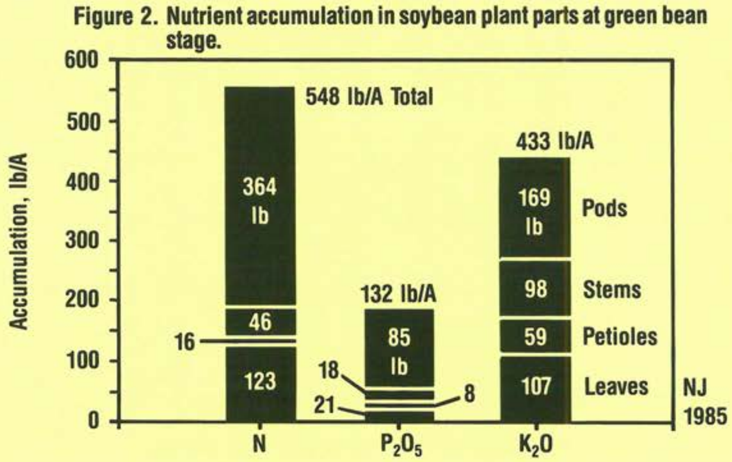
Table 2 shows the nutrient uptake per day for the various growth periods.

Table 2. Nutrient uptake per day by growth periods in soybeans.

Sampling Stage	Days in Period	Nutrient Uptake Per Day (lb) N	P_2O_5	K_2O
3 Tri-Leaf	40	.75	.25	.68
6 Tri-Leaf	11	1.45	.55	2.72
Full Bloom	16	7.81	1.75	5.75
Pod Dev.	15	9.13	2.27	9.60
Soft Seed	21	11.43	2.76	2.43
Near Mature	16	-3.38	-1.25	-2.25

The big N requirement of soybeans and strong demand relatively late in the growing period supports research the past two years in another experiment which has shown a 10 to 20 bu/A response to applied N when yield potentials are 60 bu/A or more. The greatest response occurred when the N was applied early flower and early pod-fill versus preplant.

Figure 2 shows the distribution of the major nutrients in the various plant parts at growth stage 9 (soft green seed). Note that the highest concentration of N and P (approximately 65%) is in the pods. The highest concentration of K (39%) is also in the pods, but K distribution is more uniform throughout the plant. ■



Lamb Gains Improve on Pastures Fertilized With Phosphorus and Sulfur

By M.B. Jones, D.M. Center, M.W. Demment, M.R. Dally, C.E. Vaughn, and W.A. Williams

A California study shows high potential for lamb production with intensive management of annual grasslands.

THE 20 MILLION ACRES of annual grasslands in California are usually responsive to fertilization with nitrogen (N), phosphorus (P) and sulfur (S), as shown by many small plot fertilizer trials. Animal responses to fertilization have not been as well documented by data.

This study was established at the University of California Hopland Field Station, in Northern California, with the goal of maximizing lamb production on annual-type grasslands. The N requirements were supplied by seeding 50 lb/A of subclover on a 16-acre site which had been prepared by burning the old dry grass and disking. Treatments were four levels of P, with and without S **(Table 1).** Each of the eight treatments was applied to one acre with two replications. The average Bray P_1 soil test was 9 ppm.

Lambs were weaned at about 40 lb in each of the four years and placed on the pastures at dates ranging from February 13 to March 8. The lambs remained on the pastures a minimum of 84 days each year and were weighed every 28 days. The number of lambs per acre was determined by the amount of forage on offer, so that each lamb had the same quantity of forage available to it during any given period. Minor adjustments were made by adding or removing "muncher" lambs every 28 days. "Tester" lambs remained on the same pasture throughout the grazing period.

Lambs gained an average of 34, 40, 43 and 38 lb in 1983 through 1986, respectively. In the first three years, lambs on plus S pastures gained 2 to 6 lb more than lambs on pastures without S (LSD [0.05] = 3). In the fourth year lambs gained 2 lb less where S was applied. The plus S pastures had forage levels of S above the minimum lamb requirements, but S levels in forage with no applied S were less than requirements for young growing lambs. Also there was more clover in the plus S than in the no S pastures during the first three years, but less in the fourth year. Lamb gains were directly related to clover percentages. The effect of P on lamb gain per head was not significant.

Lamb gain per acre is given in **Table 1.** Both P and S applications resulted in more pounds of lamb per acre. Differences among the three P treatments were not statistically significant. During the four year study the average of the three P treatments without S produced 471 lb more total lamb per acre than unfertilized pasture, while those with P and S produced 793 lb more. Applying S alone gave a 646 lb increase over the check treatment.

Cost

The cost of each of the treatments included $98.74 for seed, inoculation and sowing. Amortized over 15 years using a 15% rate of interest, this amounted to $16.89 per year. Clover stands can last indefinitely, but 15 years was used as an arbitrary payback period. The S was charged at $200 per ton, and amortized over two years. The P was applied as 0-45-0 and charged at $320 per ton. The 114 lb P_2O_5 rate was amortized over four years, the 57 lb P_2O_5 rate over two years, and the 28 lb P_2O_5 rate over one year. The K applied

Dr. Jones is Agronomist, Dr. Center is Post Graduate Research Ecologist, Dr. Demment is Animal Nutritionist, and Dr. Williams is Professor, all in Department of Agronomy and Range Science, University of California; Mr. Dally is Staff Research Associate, Department of Animal Science, and Mr. Vaughn is Staff Research Associate, Hopland Field Station, University of California.

DR. JONES views two different treatment areas of the pasture experiment.

to all fertilized plots added $9.40 plus $6.00 application cost when it was the only fertilizer applied in a given year. When it was applied with other fertilizers, application costs were divided among them all. We think there was very little if any response to K. If the cost of K is removed, the income due to fertilization increases further from $30 to $40 per acre.

The income from fertilization averaged for the three levels of P-only summed for four years was $199.13, for P with S was $388.10 and for S-only was $345.65. Out of this income the cost of maintaining ewes and rams and running the general ranch operation must be paid.

Potential

This study shows the high potential some of our annual grasslands have for lamb production when intensively managed. The amount of lamb produced per acre in this study is five to ten times greater than production on some of our other pastures, because in this study all of the pasture growth, except that needed for mulch (about 900 lb/A), was utilized exclusively for lamb growth. Subclover pastures can be grazed sufficiently during winter months to keep down grass competition and maintain clover stands. Then, if the production during winter and spring can be converted into saleable products such as lamb, the P and S fertilization will be profitable. ■

Table 1. Effect of P and S fertilization on 4-year lamb gain and income per acre.

Fertilizer Treatment*	4-Year lamb gain lb/A	Gain from fertilizer lb/A	Fertilizer and seed cost $	Income from gain** $	Less Seed & fert. cost $	Income due to fertilizer $
Check	1,170	0	68	757	689	0
S	1,816	646	143	1,178	1,035	346
P_1	1,571	401	167	1,014	847	158
P_1,S	1,946	776	188	1,261	1,073	384
P_2	1,758	588	169	1,129	960	271
P_2,S	1,907	737	192	1,232	1,040	351
P_3	1,595	425	171	1,028	857	168
P_3,S	2,035	865	194	1,312	1,118	429
LSD 5%	312	312				

*S = 88 & 100 lb/A elem. S before years 1 & 3; P_1 = 28 lb/A of P_2O_5 before years 1, 2, 3, & 4; P_2 = 57 lb/A of P_2O_5 before years 1 & 2; P_3 = 114 lb/A of P_2O_5 before year 1, all as triplesuperphosphate.
**The 4-year mean price for lamb was $0.65 per pound.

Starter K in Conservation Tillage Improves Soybean Yields, Seed Quality

By D.H. Rickerl and J.T. Touchton

Auburn research shows higher yields and improved seed quality are benefits of starter fertilizer, particularly K, applied for soybeans in conservation tillage.

SOYBEAN YIELDS and seed quality can be improved by use of starter fertilizer in conservation tillage systems. Mulches present in conservation tillage reduce soil temperatures and root growth may be limited. Placing small amounts of fertilizer within reach of developing seedlings can offset nutrient deficiencies caused by reduced root growth and slow nutrient release.

Field Research

A field test was designed to measure yield and quality of soybeans planted in a conservation tillage system using starter fertilizer. A fine, sandy-loam soil was selected as the site for this 3-year study. Four different fertility levels were established: 1) low phosphorous (P) and low potassium (K); 2) low P and high K; 3) high P and low K; 4) high P and high K.

The original soil fertility levels of 10 lb/A P and 24 lb/A K were used for the low PK area. Applications of 200 lb/A concentrated superphosphate and/or muriate of potash established the high soil fertility area at soil test values of 50 lb/A P and 114 lb/A K. Starter fertilizer treatments of N, P, K, NP, NK, and NPK were applied using a no-tillage planter with in-row subsoilers. Fertilizer hoppers were mounted above the subsoilers and fertilizer was allowed to fall freely behind the subsoil shank. Fertilizer sources were ammonium nitrate, concentrated superphosphate, and muriate of potash. For the NP combinations, diammonium phosphate was used. Rates were 14 lb/A N, 17 lb/A P, and 39 lb/A K.

Yields boosted with starter fertilizer

Bringing soil test P or K values from low to high increased yields by 18% in the no starter check. If both P and K were increased to high levels, soybean yields without starter were 43% greater than those in low P and low K areas **(Table 1)**.

Table 1. Soybean yields—3-year average.

Fertility level	Starter fertilizer							
	0	N	P	K	NP	NK	PK	NPK
P-K rating	bu/A							
Low-low	19	23	28	30	23	30	28	24
Low-high	22	30	32	33	27	33	32	26
High-low	24	29	32	36	27	34	34	30
High-high	28	30	34	35	28	36	35	29

Starter fertilizer improved yields regardless of fertility level. Average yield improvements with starter were 40-50% when soil test P and/or K levels were low. Even in high soil test P and K areas, yields were increased by 26% with starter fertilizer compared to the check. The best starter fertilizers were P or K alone and NK or PK combinations. Generally K was the key ingredient to high yields, while the N containing starters were less effective.

Seed quality an added benefit of starter K

Seed quality and weight per hundred seed were improved by starter fertilizer, but did not vary among soil fertility levels. Seed quality was visually rated from 1-5 with 1 being good and 5 being poor. Again, K was a key ingredient. Quality ratings ranged from 2.0 with K or NK starter to 2.6 in the no-starter check. Visual differences in seed quality can be

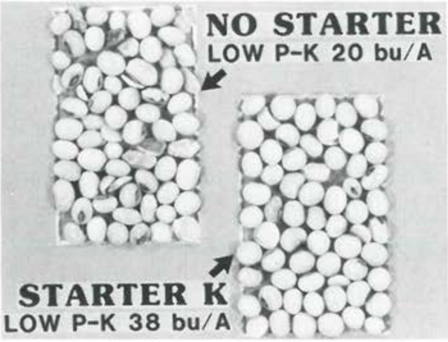
Dr. Rickerl is Assistant Professor, Department of Plant Science, South Dakota State University, Brookings, and a former graduate student at Auburn University. Dr. Touchton is Professor, Department of Agronomy and Soils, Auburn University.

seen in the photo taken in the first year of the test. Seed weight was increased by 12% with K, NK, and PK starter fertilizer when compared to the check **(Table 2)**.

Table 2. Soybean quality and seed weight.

Starter Fertilizer	Quality* rating	Seed weight
	1-5	oz/100
0	2.6	.47
N	2.3	.48
P	2.3	.50
K	2.0	.53
NP	2.4	.49
NK	2.0	.52
PK	2.1	.52
NPK	2.4	.51

*Quality rating scale: 1=good, 5=poor



VISUAL differences in seed quality are apparent in seed samples from treatments with and without starter K.

Summary

Starter fertilizer improved soybean yields regardless of soil fertility level, but did not replace the need for high soil test values. The most important starter fertilizer ingredient was K. Yields in low P-K soils without K starter fertilizer were almost half those of high PK soils with K starter fertilizer. An added benefit of K starters was the improvement in seed quality. ■

Dr. David W. Dibb Named Adjunct Professor of Agronomy at Purdue

DR. DAVID W. DIBB, Potash & Phosphate Institute (PPI) Vice President for Domestic Programs, has been appointed Adjunct Professor of Agronomy at Purdue University, West Lafayette, Indiana. Dr. Dibb continues in his position with PPI. As Adjunct Professor, he is invited to participate in seminars and staff meetings, on graduate committees and in other Purdue activities, according to Dr. Marvin W. Phillips, Department Head.

Dr. Dibb moved to the PPI office at West Lafayette in 1985, succeeding Dr. Werner L. Nelson as PPI Vice President for Domestic Programs. Dr. Nelson also had the title of Adjunct Professor of Agronomy at Purdue. ■

Dr. Harold F. Reetz, Jr. Reappointed Collaborator at University of Illinois

DR. HAROLD F. REETZ, JR., PPI Southcentral Director, has been reappointed as Collaborator with the College of Agriculture of the University of Illinois at Urbana-Champaign for the 1986-87 academic year.

The title is given in recognition of cooperation with the university staff, particularly in the Department of Agronomy, according to John R. Campbell, Dean, College of Agriculture. ■

Setting the Table for Profits

By W.K. Griffith

Plant food utilization (PFU) information can be a useful tool in providing optimum nutrient levels for maximum economic yields (MEY).

DINNER TIME! A great sound to a hungry person. Has the table been set to satisfy? Is it served on time, balanced, palatable and enough to go 'round? If so, we are bound to be satisfied.

Like you, profitable crop production requires a table which is set to satisfy. Maximum yield research and maximum economic yield demonstrations the past few years have taught us a very important concept: **To produce crops at high and profitable yield levels, all inputs must be given precision management and integrated into a total production package.** The table is built by integrating the best varieties/hybrids, planting dates, seeding techniques, pest control measures, populations, row spacings and other inputs into a systems approach. To get the profit advantage from this planning, the table must be set with adequate plant foods.

Are P or K Limiting Yields?

Too often phosphorus, potassium, or one of the other nutrients is the most limiting factor in an otherwise profitable cropping system. Why? Fertilizers are a direct out-of-pocket variable cost. Such costs are watched closely and are subject to being cut, especially when times are tough. The key is to maintain optimum management for all inputs in the system and to concentrate on reducing costs per unit of production rather than costs per acre.

This issue of *Better Crops* features plant food utilization (PFU) by crops. The information presented is the latest available from research results on numerous crops. PFU is not an exact science. The data presented are "best-fit" or average values from numerous studies across a wide geographic area. Results from a specific study can vary considerably.

Profitable crop production requires a thorough understanding of the crop's nutrient needs and then setting the table for selected yield goals.

This is a two-part thought process. One part of fertility management is to know the amount of nutrients taken off a field in the harvested portion so that fertilizer recommendations can be made to maintain soil test levels and meet succeeding crop requirements. The second part of fertility management is to know the total uptake during the growing season and when during the season the demand is greatest for each nutrient. Adequate amounts must be available in the rooting zone throughout the growing season and, particularly at peak use periods, to meet the needs of the growing crop. The table below gives PFU data for corn, wheat and soybeans that can be used in developing a P and K fertility program.

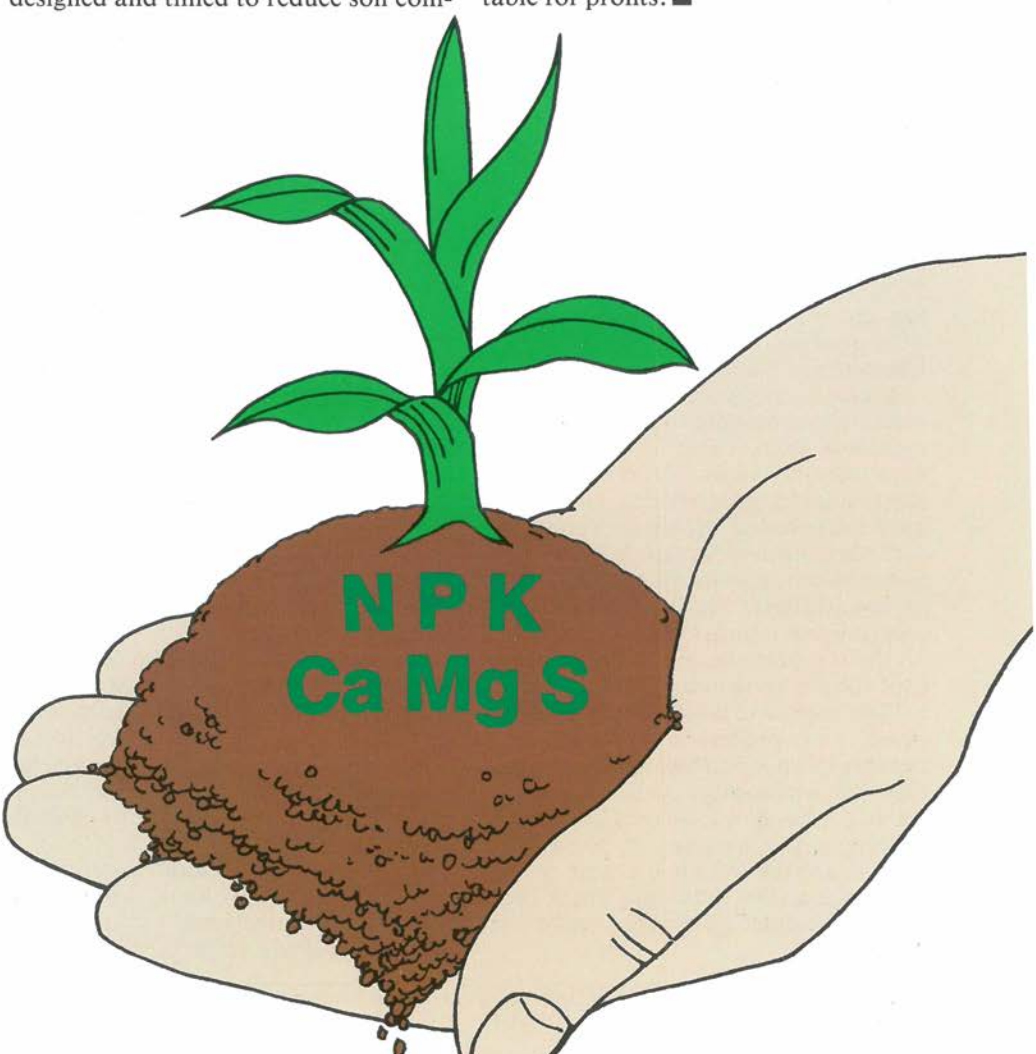
Crop/ Nutrient	Total Uptake lb/bu	Percent Uptake Vegetative Stage	Removal in Grain lb/bu
Corn			
P_2O_5	0.5 lb	41% by early tassel	0.44 lb
K_2O	1.2	83% by early tassel	0.29
Wheat			
P_2O_5	0.7	65% by boot	0.55
K_2O	2.0	90% by boot	0.34
Soybeans			
P_2O_5	1.2	42% by flower	0.80
K_2O	2.4	53% by flower	1.40

Dr. Griffith is Eastern Director, Potash & Phosphate Institute (PPI).

For example, a farmer with a 70 bu/A wheat crop will remove 24 lb K_2O/A in the grain. However, it takes 142 lb K_2O/A to grow the crop and 90% of this total, or 128 lb K_2O, is taken up by boot stage. In this example, if potash needs are met, what else will be necessary to set the table for a 70 bushel wheat crop?

When considering P and K requirements, several factors must be evaluated: Have we soil tested before seeding? Will soil test buildup as well as maintenance applications be needed? Are tillage and planting techniques designed and timed to reduce soil compaction and improve soil structure? What is the moisture holding capacity of the soil and are moisture conservation or drainage techniques used? Are application methods used to assure adequate uptake at low soil temperatures? Are row and/or split P or K applications needed? Have we set an optimistic, but realistic, yield goal based on all our management decisions?

By combining the answers to these types of questions with knowledge of the amount of nutrients taken up for the yield goal and crop involved, we can arrive confidently at the optimum fertilizer recommendation in setting the table for profits. ■



Potash Helps Reduce Ammonia Loss in the Field with Surface-Applied Urea

By L.B. Fenn

Reducing ammonia losses of surface-applied urea can mean a real economic benefit to growers in some field conditions. Texas research shows good results using potash added with urea to control ammonia loss.

CONCERN over ammonia loss discourages the general use of urea for surface fertilizer application. Ammonia losses occur only when the soil surface is moist and the temperature is above freezing. Plowed soils without fresh organic materials on the surface do not favor high levels of ammonia loss because they dry too rapidly. Pasture, orchard, no-tillage and topdressed winter wheat (more common in the southern US) are prime candidates for loss of ammonia from urea.

Urea is the lowest cost dry nitrogen (N) product in most areas. The loss of ammonia from urea reduces the economic advantage, but not enough to make other products preferable. Losses of ammonia N need not occur; prevention will increase the return to the farmer from each unit of N applied.

Chemistry of Controlling Ammonia Loss

If urea is incorporated into the soil, it is securely surrounded by soil particles (no ammonia loss). Most soils have large amounts of calcium adsorbed onto the negatively charged particles. This breaks away from the soil and combines with the carbonate formed from urea breakdown (ammonium carbonate) to form calcium carbonate (lime). The free and positively charged ammonium replaces the calcium on the soil particles and is immobilized (not subject to ammonia loss).

Urea applied to the soil surface decomposes and produces ammonia loss because it is not surrounded by calcium-rich soil. Ammonium carbonate, an unstable compound, is formed but rapidly decomposes to the gases, carbon dioxide and ammonia, which are lost to the atmosphere. The ammonia losses from urea can be significant under certain conditions.

The rate of ammonia loss is largely controlled by environmental conditions. Those which favor high losses include moist soil surfaces; high relative humidity, such as fog or heavy morning dews; and high levels of organic litter on the soil surface. Conditions which do not favor loss include dry soil surface; dry air; lack of organic residue; and rainfall or irrigation soon (few hours) after urea application.

Our research at El Paso noted that calcium and magnesium salts combined with urea on the soil surface reduced ammonia loss markedly. This information led to the development of a process in which calcium or magnesium nitrates or chlorides are incorporated with urea to stabilize it on the soil surface. The calcium or magnesium salts inhibit the formation of gases on the soil surface much like calcium does below the surface.

Later experiments showed that potassium (K) added with urea could replace calcium and magnesium from the soil and prevent ammonia loss. Potassium replaces the adsorbed calcium on the soil particles and the freed calcium reacts with ammonium carbonate (the decomposition product of urea) to form insoluble calcium carbonate.

Advantages of potassium to control ammonia loss are obvious. Most soils east of the Rocky Mountains are deficient in potassium and require its application as a fertilizer. Thus, two required nutrients can be added in a single operation, reducing application costs while also controlling ammonia losses.

Formulation

Calcium, magnesium or potash used with urea are effective at a minimum of one chemical equivalent of the additives

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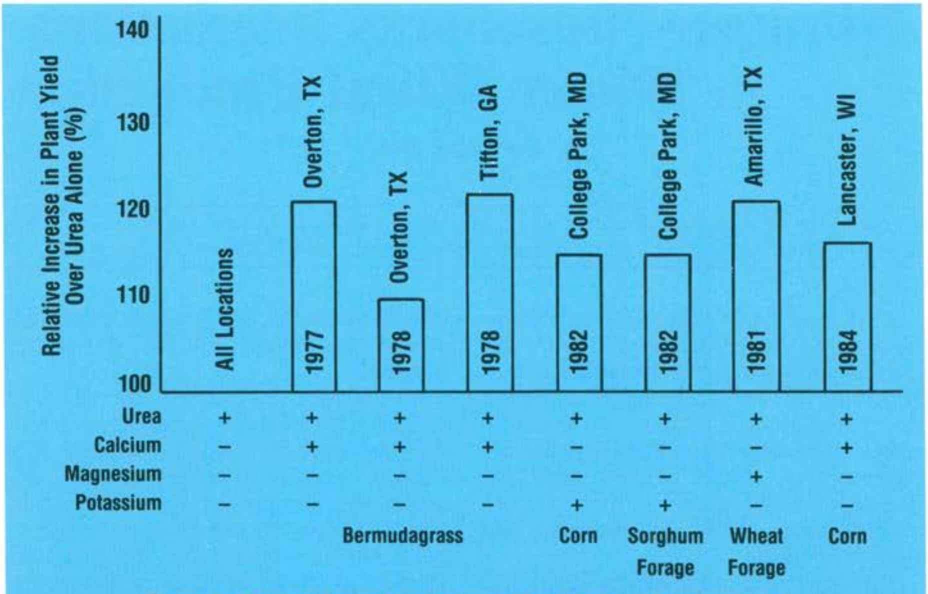

Figure 1. Crop production from urea without and with neutral salts.

to four chemical equivalents of urea but are most effective at ratios of one chemical equivalent of additive to 2 chemical equivalents of urea (1.36, 0.8, 0.94 lb potash, magnesium or calcium chloride per lb urea, respectively).

These additives can be applied with urea in liquid, suspension or dry form. The liquid products would include calcium or magnesium with urea. Dry products of calcium or magnesium with urea can be made but only with specialized equipment. Potash must be added to urea as a suspension when used as a liquid. It can also be used in dry form co-granulated with urea or as a dry blend if applied in a band by an air flow system or by the old fashion dribble spreaders.

Field Data

Yield data from field studies with urea, ammonium nitrate, calcium nitrate compared to urea + calcium, magnesium or potassium salts are found in **Figure 1**.

Remember that these additives are designed to be effective only under conditions where ammonia loss would occur. Results obtained where environmental conditions did not support ammonia loss will generally show reduced beneficial results of the additives (calcium stimulated ammonium absorption by plants can still occur even when ammonia loss does not occur).

Experiments using urea + calcium gave significantly better results than those using ammonium nitrate, a non-ammonia producing fertilizer in an acid and neutral soil. This stimulated yield phenomena is technically known as the "Viets Effect", a calcium enhancement of ammonium absorption. The ramifications of this phenomenon are being studied at El Paso. It offers one additional benefit of calcium added with urea.

Economic Benefits

This technology can greatly benefit farmers who grow pastures, field crops, turfgrasses, and vegetables. Laboratory, greenhouse, and field tests have shown that the newly formulated fertilizer materials:

- increase cost effectiveness of surface-applied urea by decreasing ammonia losses;
- stimulate ammonium absorption by roots which enhances plant growth;
- combine the use of required nutrients (potash) with urea into one application operation;
- succeed under a wide range of field conditions.

(continued on page 17)

Nitrogen-Phosphorus Interactions in Winter Wheat Production

By C.A. Grant

Research in Manitoba shows the importance of balanced N and P application to optimize overwintering ability of wheat and to attain maximum economic yield.

BALANCED nitrogen (N) and phosphorus (P) fertilization is extremely important for maximum economic yields of winter wheat. This is especially true in the prairie regions of Canada and the northern United States where winter stresses are particularly severe. Good fertilizer management is required to optimize both overwintering ability of the plant and final crop yield.

It is commonly believed that high levels of N fertilizer will decrease the ability of a winter wheat stand to survive over the winter, while applications of P fertilizer will increase survival. Studies conducted by the Crop Development Centre in Saskatchewan indicate that applications of N at commercial rates either as broadcast applications or banded away from the seed do not necessarily decrease the amount of cold hardiness attained by the plant in the fall. But, high levels of fall-applied N may cause plants to lose their hardiness earlier, leaving the plants susceptible to winterkill in the later winter months.

Application of P helps the plants to maintain their hardiness longer, decreasing the chances of winterkill in the late winter period. Phosphorus also encourages spring regrowth of roots that were damaged during the winter, and so helps the plant to begin the vigorous spring growth required for good yields.

The beneficial effects of balanced N and P fertilization on winter field survival of winter wheat grown under zero tillage management in Manitoba are shown in **Table 1.** Application of high rates of N broadcast as 34-0-0, decreased the number of plants of Norstar winter wheat that successfully overwintered. Phosphorus fertilizer (11-48-0) placed with the seed had no influence on winter survival when no N fertilizer was applied, but helped to reduce winterkill when applied with high

Table 1. Survival of Norstar winter wheat under zero-tilled and conventionally tilled conditions with levels of N and P.

Treatment		1979-1980	1980-1981	
N	P_2O_5	Zero-tilled winter survival	Zero-tilled winter survival	Conventionally tilled winter survival
lb/A		%		
0	0	56.7%	74.5%	35.4%
54	0	49.7	69.9	25.7
107	0	50.6	59.7	26.0
0	18	70.6	75.0	42.7
54	18	56.5	76.6	44.0
107	18	48.8	69.5	40.0
0	45	55.5	70.8	51.2
54	45	67.3	78.6	49.3
107	45	50.3	74.1	39.0

Dr. Grant is with Agriculture Canada, Brandon Research Station, Manitoba, Canada. In 1984, she was awarded a PPI Fellowship in recognition of excellence while a graduate student at the University of Manitoba.

Table 2. Grain yield as affected by N and P fertilizer applied at time of seeding.

Rate of applied		1979-1980 zero-tilled Norstar	1980-1981 Zero-tilled Norstar	1980-1981 Zero-tilled Winalta	1980-1981 Conventionally tilled Norstar
N	P_2O_5				
---------lb/A---------		---bu/A---			
0	0	18.9	14.4	17.7	20.8
54	0	31.2	41.3	39.2	36.4
107	0	35.3	47.4	45.3	42.2
0	18	30.7	16.8	15.4	20.2
54	18	38.2	41.9	39.9	37.7
107	18	42.3	54.2	47.8	50.9
0	45	35.2	20.2	20.6	27.8
54	45	38.5	46.2	48.7	41.7
107	45	42.6	64.2	57.3	54.2

rates of N fertilizer. Therefore, for the best overwintering of winter wheat, **adequate levels of P must be applied at the time of seeding, particularly if high rates of N are applied in the fall.**

Balanced N and P fertilization is equally important for production of maximum economic yield of winter wheat. Yield potential of a crop is largely determined by the first limiting factor. In dryland agriculture, growing season moisture generally provides the upper limit for crop yield in a particular year. N and P, as well as other nutrients, must be provided in sufficient amounts to bring the crop to the yield potential dictated by the available moisture. If either N or P is in short supply, the crop will not be able to take advantage of the moisture and other nutrients available for growth, and the goal of maximum economic yield will not be attained.

Table 2 shows the effect of N and P on the yield of Norstar winter wheat grown in Manitoba under both conventional and zero tillage management. N was applied as ammonium nitrate (34-0-0) broadcast at the time of seeding, while the P was applied as monoammonium phosphate (11-48-0) with the seed. N fertilizer increased the yield of the winter wheat, even in the absence of applied P, in spite of the reduced winter survival which resulted. An adequate stand remained and the winter wheat was able to compensate to some extent for reductions in plant number by increasing tillering, spikelet number and seed size. P fertilizer applied without additional N also led to an increase in yield as compared to the unfertilized check. However, the highest yield occurred when both N and P were applied together.

In order to make best use of the fertilizer dollar, a balanced program of fertilizer use is an essential part of a management system. A deficiency of N, P and any other nutrient can fix crop yields at a lower than optimum level, leading to inefficient use of available moisture, fertilizer and other inputs. By following a program of balanced fertilizer applications, growers can optimize yields and income per acre. ■

(Potash with urea. . . from page 15)

Plant Growth Enhancement

Labeled N has been used to trace the movement of ammonium nitrogen in the soil and plant. There is strong evidence that more ammonium N was absorbed by roots in the presence of calcium with broccoli and barley plants (unpublished data).

At the Experiment Station in El Paso, we tested a variety of crops under greenhouse and field conditions and concluded that the increased N uptake significantly increases plant growth and crop yields in many cases. ■

Some Hybrid Bermudagrasses Have Higher Potassium Requirements

By W.B. Hallmark, M.C. Amacher and L.P. Brown

Louisiana research shows that higher potassium (K) soil levels are important for high yield production with some of the newer hybrids.

RESEARCH in recent years indicates that bermudagrass requires higher fertilizer rates than were formerly considered necessary. Studies in Louisiana show that a 10 ton/A crop of Coastal bermudagrass hay removed 400 lb of nitrogen (N), 115 lb of phosphate (P_2O_5), and 530 lb of potassium (K_2O) from the soil.

At these levels of yield and nutrient removal, the soil profile will eventually be depleted of nutrients with a consequent decline in yield unless high rates of fertilizer are used. Although much bermudagrass fertility work has been done, there is little information on the effects of bermudagrass varieties and hybrids on soil K status, or whether bermudagrasses differ in yield sensitivity to soil K level.

To better evaluate the K requirements of bermudagrass, 15 hybrids and varieties were grown at either 0 or 500 lb K_2O/A. The study was initiated in 1980 and K application became a variable in 1982.

Bermudagrass varieties and hybrids had no significant effect on soil K in early 1982, two years after establishment **(Table 1).** However, by 1984 differences in soil K were found at both K application rates.

By comparing soil K in 1982 and 1984, it can be seen that K decreased with time for 12 bermudagrasses at the zero K rate and three bermudagrasses at the 500 lb K_2O rate. The decreases in soil K at zero K (average of 36 ppm for 15 bermudagrasses) was expected since no K was added to replenish it.

However, the decreases in soil K at the 500 lb K rate (average of 16 ppm for 15 bermudagrasses) were not expected because of the 500 lb K_2O added to replace that removed from the soil. The high K usage indicates that higher rates of K_2O than were used in this experiment are needed to maintain soil K levels.

The effect of K application on soil K and yield of the 15 bermudagrasses for two years is shown in **Table 2.** Callie Giant was the only entry in the test to give a yield response to K in 1982.

In 1984, there were 11 bermudagrasses with decreased soil K levels where K was not applied **(Table 2).** Five of the 11 bermudagrasses with decreased soil K had corresponding decreases in yield. However, the other six bermudagrasses did not show a significant loss of yield during 1984.

Based on the results for 1984, it can be seen that the soil K level at which yields declined differed among varieties and hybrids. Dry matter yields of Ga. 77-58 declined when soil K fell to 117 ppm; Okla. 6-7, when K fell to 144 ppm; Callie Giant, when K fell to 119 ppm; Ga. 77-26, when K fell to 126 ppm; and Grazer, when K was less than 146 ppm.

This contrasts with the results for Brazos, Ga. 77-56, OSU LCB W-26, OSU LCB E-1, Tifton 44, and Common where soil K levels for the zero K treatments fell to 126, 107, 126, 122, 128 and 141 ppm K, respectively, without a decline in yield. These results indicate

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L.P. Brown is Research Associate, Iberia Research Station.

that bermudagrasses differ in yield sensitivity to soil K level. They also show that the 100 ppm soil K level that is now considered adequate is not high enough for some bermudagrasses.

In summary, bermudagrasses differed significantly in their effect on soil K level. With the yields obtained in this study, 500 lb/A K_2O was not enough to restore soil K levels. The present recommended K application for bermudagrass hay grown on an alluvial soil in Louisiana is 200 lb/A K_2O. To maintain high yields, it may be necessary to use 600 lb/A K_2O or more to keep soil K from being depleted.

The bermudagrasses grown in this study differed in soil K level at which yields began to decline. This indicates that it may be necessary to consider which bermudagrass is being grown when making K fertilizer recommendations. Also, the 100 ppm K level now considered adequate in Louisiana needs to be reevaluated and set at a higher level. ■

Table 1. Effect of bermudagrass cultivars and hybrids, K application rates and time on soil K levels and cumulative yields for an Iberia silty clay.

Entry Name	K_2O Applied lb/A	1982	1984	Change
		------ppm K/A ------		
Brazos	0	169	126	- 43
Ga. 77-58	0	151	117	- 34
Okla. 6-7	0	178	144	- 34
Ga. 77-56	0	149	107	- 42
Callie Giant	0	153	119	- 34
OSU LCB W-26	0	174	126	- 48
Alicia	0	162	122	- 40
OSU LCB E-1	0	166	122	- 44
Ga. 77-26	0	169	126	- 43
Coastal	0	162	117	- 45
Tifton 44	0	186	128	- 58
Grazer	0	164	146	- 18
Ga. 77-11	0	159	121	- 38
Common	0	154	141	- 13
Ga. 72-50	0	136	131	- 5
Brazos	500	178	160	- 18
Ga. 77-58	500	150	141	- 9
Okla. 6-7	500	203	174	- 29
Ga. 77-56	500	177	144	- 33
Callie Giant	500	166	148	- 18
OSU LCB W-26	500	185	160	- 25
Alicia	500	159	136	- 23
OSU LCB E-1	500	205	167	- 38
Ga. 77-26	500	167	147	- 20
Coastal	500	141	125	- 16
Tifton 44	500	169	158	- 11
Grazer	500	168	180	+ 12
Ga. 77-11	500	148	132	- 16
Common	500	184	176	- 8
Ga. 72-50	500	135	142	+ 7

Table 2. Effect of K application rates on soil K and yield for fifteen bermudagrasses for two years.

Entry Name	K_2O Applied lb/A	1982 Soil K ppm	1982 Yield T/A	1984 Soil K ppm	1984 Yield T/A
Brazos*	0	169	11.9	126	12.3
	500	178	12.5	160	12.5
Ga. 77-58*	0	151	9.1	117	10.8
	500	150	9.8	141	12.5
Okla. 6-7*	0	178	10.6	144	10.0
	500	203	11.0	174	12.3
Ga. 77-56*	0	149	9.7	107	11.6
	500	177	10.2	144	12.0
Callie Giant*	0	153	9.7	119	10.1
	500	166	11.4	148	12.0
OSU LCB* W-26	0	174	10.9	126	11.6
	500	185	10.7	160	11.9
Alicia	0	162	9.6	122	10.9
	500	159	10.1	136	11.6
OSU LCB* E-1	0	166	9.7	122	11.2
	500	205	10.0	167	11.4
Ga. 77-26*	0	169	9.4	126	9.9
	500	167	10.4	147	11.2
Coastal	0	162	9.7	117	10.1
	500	141	9.5	125	10.7
Tifton 44*	0	186	8.6	128	10.1
	500	169	8.8	158	10.4
Grazer*	0	164	7.2	146	7.9
	500	168	7.8	180	8.7
Ga. 77-11	0	159	8.1	121	7.2
	500	148	8.1	132	8.5
Common*	0	154	6.4	141	7.4
	500	184	6.2	176	7.6
Ga. 72-50	0	136	6.8	131	5.0
	500	135	7.0	142	6.6

[1]Half of the potassium was applied in March of the indicated year and the remaining half was applied in July after the 3rd and 2nd harvests, respectively, for 1982 and 1984.

*Indicates bermudagrasses with decline in soil K significant at .05 level.

Plant Food Uptake for Crops by Region

PLANT nutrient needs increase as yield levels increase. Knowledge of plant food uptake and removal will be useful in setting yield goals and in considering other crop management decisions.

The Potash & Phosphate Institute (PPI) has available wallet-sized folders with uptake and removal figures for major crops by region. (Midwest and Southern versions are ready now, Great Plains and Western U.S. versions will be available soon. Turn to page 23 for more information).

PLANT FOOD UPTAKE (PFU) for Southern Crops

CROP	YIELD/ACRE	N	P_2O_5	K_2O	Mg	S
		Nutrient Uptake, lb/A**				
CORN	120 bu	160	68	160	39	20
	180 bu	240	102	240	58	30
	220 bu	290	125	290	72	36
SOYBEANS*	25 bu	148	23	87	10	8
	40 bu	224	38	144	16	14
	55 bu	288	53	188	22	18
	70 bu	364	67	220	28	22
COTTON	750 lb lint	105	45	65	17	15
	1,500 lb lint	180	63	126	35	30
WHEAT	40 bu	75	27	81	12	10
	70 bu	130	47	142	21	18
	100 bu	188	68	203	30	25
ALFALFA*	4 tons	225	60	240	20	20
	6 tons	338	90	360	30	30
	8 tons	450	120	480	40	40
BERMUDAGRASS	6 tons	258	60	288	18	30
(HYBRIDS)	8 tons	368	96	400	26	44
FESCUE	3 tons	114	56	158	11	12
	6 tons	228	112	316	22	24

*Legumes get most of their nitrogen from the air

HIGH YIELD CHECK LIST

High yields begin with:

- COMMITMENT
- YIELD GOALS
- PLANNING
- MANAGEMENT

Check inputs, practices, and equipment

Timeliness with every practice
Soil selection and testing
Equipment check and adjustments
Tillage and seedbed preparation
Rotation
Variety or hybrid selection
Water management—drainage and irrigation
Quality seed
Planting date
Population
Spacing—row width—within the row
Control pests early
Fertile soil
  pH 5.8 to 6.5
  Soil P and K levels testing high
  N by yield goal
  Starter fertilizer
Harvest early and reduce harvest loss
Keep good records

PLANT FOOD UPTAKE (PFU) for Midwest Crops

CROP	YIELD/ACRE	N	P_2O_5	K_2O	Mg	S
		Nutrient Uptake, lb/A**				
CORN	120 bu	160	68	160	39	20
	160 bu	213	91	213	52	26
	200 bu	266	114	266	65	33
SOYBEANS*	40 bu	224	38	144	16	14
	60 bu	315	58	205	24	20
	80 bu	416	78	250	32	26
ALFALFA*	4 tons	225	60	240	20	20
	6 tons	338	90	360	30	30
	8 tons	450	120	480	40	40
WHEAT	50 bu	94	34	102	15	13
	75 bu	141	51	152	23	19
	100 bu	188	68	203	30	25
GRAIN	4,500 lb	133	47	135	22	21
SORGHUM	7,500 lb	222	79	225	38	35
FESCUE	3 tons	114	56	158	11	12
	6 tons	228	112	316	22	24

*Legumes get most of their nitrogen from the air

**Figures given are total amounts taken up by the crop in both the harvested and the above ground unharvested portions. These numbers are estimates for indicated yield levels, taken from research studies, and should be used only as general guidelines.

PLANT FOOD REMOVED IN HARVESTED CROP

CROP	UNIT	N	P_2O_5	K_2O
CORN	lb/bu	.75	.44	.29
SOYBEANS	lb/bu	4.00	.80	1.40
GRAIN SORGHUM	lb/cwt	1.50	.75	.38
WHEAT	lb/bu	1.15	.55	.34
OATS	lb/bu	.80	.25	.20
BARLEY	lb/bu	1.10	.40	.35
SUNFLOWER	lb/cwt	3.60	1.70	1.10
ALFALFA	lb/ton	56.00	15.00	60.00
CORN SILAGE	lb/ton	8.30	3.60	8.30
TALL FESCUE	lb/ton	38.00	18.00	52.00
CLOVER/GRASS	lb/ton	50.00	15.00	60.00
SORGHUM/SUDAN	lb/ton	40.00	15.00	58.00
POTATOES	lb/cwt	.35	.15	.56
TOMATOES	lb/ton	3.60	1.70	7.20
SUGAR BEETS	lb/ton	4.20	.50	8.30
TOBACCO (FLUE)	lb/cwt	2.80	.50	5.20
TOBACCO (BURLEY)	lb/cwt	4.30	.43	4.70

Dr. R.D. Munson, Barbara Martin, and Jean Watkins Retire at PPI

RETIREMENTS of three veteran employees of the Potash & Phosphate Institute (PPI) were recently announced by Dr. R.E. Wagner, President of the Institute.

Dr. R.D. Munson, PPI Northcentral Director, and **Mrs. Barbara Martin,** PPI Circulation Manager, accepted an early retirement-incentive program, effective September 1, 1986. **Mrs. Jean Watkins,** secretary in the West Lafayette, Indiana office, took normal retirement June 30, 1986.

Dr. Munson joined the American Potash Institute (now PPI) staff in 1958 as Agronomist. In recent years, he has directed the Institute's programs in Minnesota, Iowa and Wisconsin, from his office in St. Paul, Minnesota. He has served as Midwest Director, and worked in fifteen different states in the Midwest, Northwest and West.

Dr. Munson graduated with a B.S. degree in Agronomy from the University of Minnesota in 1951.

In 1954, he earned his M.S. in Soil Fertility from Iowa State College (now University). In 1957, he received his Ph.D. in Soil Fertility from Iowa State, with a first minor in Agricultural Economics.

Dr. Munson was employed by the Tennessee Valley Authority (TVA) during 1957-58 as Agricultural Economist in charge of TVA's agronomic-economic research projects in the U.S.

Dr. Munson has a keen appreciation and interest in all aspects of crop production. His probing questions have caused extension and research agronomists, agribusiness personnel and farmers to rethink their approach or management. His strong concern for diagnosing problems in the field has caused many to reassess their overall programs, whether it be on a research plot or a large farm.

During his 28-year career with the Institute, Dr. Munson served in several special assignments and was recognized for important contributions to agronomic research and education programs.

Dr. Munson

Mrs. Martin

Internationally, he studied potassium, calcium and magnesium in the tropics and subtropics and prepared a technical bulletin for the International Fertilizer Development Center (IFDC). Dr. Munson also lectured in the People's Republic of China on potassium in soils and crops, for the Potash Agronomy Program.

His numerous honors and awards include: American Association for the Advancement of Science, Fellow, 1963; American Society of Agronomy, Fellow, 1974; Soil Science Society of America, Fellow, 1976; Crop Science Society of America, Fellow, 1985; American Society of Agronomy, Agronomic Service Award, 1976; American Forage and Grassland Council, Merit Certificate Award, 1983.

Dr. Munson is a member of FarmHouse, Alpha Zeta, Gamma Sigma Delta, and Sigma Xi.

He and his wife, Mary Jane, have three adult children.

Mrs. Martin began working for the American Potash Institute (now PPI) in 1954 and served as Circulation Manager over 32 years. She plans to return to the area of Mountain Lake Park, Maryland.

Mrs. Watkins was employed by the Institute in 1968, serving as secretary to Dr. Werner L. Nelson and most recently for Dr. David W. Dibb.

Effective September 1, William R. "Bill" Agerton's role was shifted to Circulation Manager and Visual Aids Coordinator in the PPI headquarters office in Atlanta. ■

THE PROBLEM: Poor early wheat growth.

Plant Problem Insights

for Maximum Economic Yields (MEY)

POOR early wheat growth can limit your yields and profits in many ways:

- **Delayed maturity—later harvest**
- **Increased weed competition**
- **Inefficient use of nitrogen**
- **More soil erosion losses**

Phosphorus (P) is one of the most important nutrients in developing early wheat growth, especially in the cool weather of late fall, winter, and early spring when soils are cold.

The photo shows how added P increased early wheat growth (right) compared to where no P was added (left). Adequate nitrogen was supplied on both sides.

This improved growth can mean less winterkill, less erosion and fewer weed problems. The earlier maturity that results with good P nutrition is especially important if you are going to doublecrop. A few days earlier harvest can make a big difference.

As you plan your wheat fertility program, make sure you check the soil P level, and include adequate P in your plans. It can help develop the vigorous early wheat growth necessary to avoid many problems.

Other conditions along with inadequate P can cause poor early growth: inadequate moisture, compacted soils, low quality seed, inadequate N or K, low pH, insects or disease. With an adequate fertilizer program including P you can look for better early wheat growth and higher yields and profits. ■

*This message is available on a 3½ x 7½-inch information card. Other topics also currently available in the "Plant Problem Insights" series are: **Poor Early Corn Growth, Weak and Thinning Alfalfa Stands, Lodged Corn,** and **Soybean Cyst Nematode.** For more information, contact: Potash & Phosphate Institute (PPI), 2801 Buford Hwy., NE, Atlanta, GA 30329 (404) 634-4274.*

Information Materials from PPI

	Quantity	Cost
Plant Problem Insights for Maximum Economic Yields See page 22. This is a colorful series of photo-cards, each with a concise discussion of a specific field problem, along with positive tips for increasing yields and profits. Specify your choices: **Poor Early Corn Growth ____; Weak and Thinning Alfalfa Stands ____; Lodged Corn ____; Poor Early Wheat Growth ____; Soybean Cyst Nematode ____. Cost per card: 10¢ each (5¢ MC*)**	________	$ ______
P and K. . .Cutting Back and Losing Out This new publication cautions farmers about potential losses from omitting fertilizer. (Folder) **Cost: 25¢ each (15¢ MC*)**	________	$ ______
Plant Food Uptake (PFU), for crops by region Handy wallet-size cards list nutrient needs of crops at various yield levels, and the amounts removed in crop harvest. (Specify region: Midwest __ South __) **Cost: 15¢ each (10¢ MC*)**	________	$ ______
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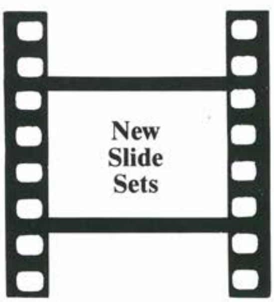

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Let's Face the Facts

"Where are you going?"
"Don't know."
"Good, can't get lost then."

FOR YEARS we've been told that hunger is about to envelop the earth. Books such as "Famine 1975" and "The Hungry Planet" were very convincing.

Prominent scientists revived Malthus' theory. (Malthus knew little of chemicals and plant genetics.) Within the past decade, farmers were urged to plant fencerow to fencerow. Many did. Exports boomed.

Then things took a turnabout. The U.S. export market shrunk. World farm surplusses depressed farm prices. Excuses were offered to U.S. farmers—embargoes, the value of the dollar, fine weather, etc.

Even now farmers wonder why they can't get better crop prices when "half the world's people go to bed hungry." But, do half the people go to bed hungry?

1. Supply has grown faster than demand. During the past four years, increase in annual world output of grains and oilseeds has exceeded increase in annual world consumption by nearly 40%.

2. The largest production increases have come from third world countries—exceeding most predictions substantially.

3. This trend is likely to continue. Actually additional worldwide cropland is plentiful. Technology is improving.

4. So, half the world does not go to bed hungry because of any food shortage.

What, then, are the choices of the American farmer? Produce only for self needs and give up the export income? This means many acres of idled farmland—retreat by one of our most efficient industries.

Isn't a better answer—**lower production costs per unit** plus negotiated fair competitive trade agreements?■

—*J. Fielding Reed*

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