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# Better Crops

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January-February, 1959

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**WITHOUT  
POTASH**

**BELL PEPPER NEEDS PLENTY OF POTASH FOR NORMAL GROWTH**



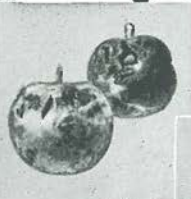
**WITH  
POTASH**

Cauliflower: left, boron treated; right, brown curd with boron deficiency



Alfalfa yellows and rosetting due to boron deficiency

**EXAMPLES OF  
BORON DEFICIENT  
CROPS**



Apples with external cork cracks, necrotic areas and dwarfed



Tobacco with die-back of terminal bud rolling of upper leaves

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## ON THE COVER . . .

. . . we see that pepper plants must be continuously supplied with potash for normal growth.

These plants were grown in experiments at the Georgia Mountain Experiment Station, in an area of north Georgia where 10 tons per acre are not uncommon.

In their article, *starting on page 6*, M. B. Parker, J. E. Bailey, and H. D. Morris report on tests started at the Georgia station in 1954 and continued to the present.

Treatments have consisted of nitrogen, phosphate, and potash with a lime variable included in two of the studies.

Among the interesting results they have observed are:

1—Pepper yields were increased by N, P, K, and lime. But lack of potash cut yields more than lack of nitrogen or phosphate.

2—Monetary returns from applying each nutrient were striking—with the greatest economic return coming from the application of potash.

3—Lime benefited plant growth and increased pepper yields. But it was ineffective on some yields when potash treatments were less than 100 pounds per acre.

4—Pepper yields were increased by adding a complete fertilizer on a low fertility soil—sometimes as much as 2.9 tons per acre over the control crop. And when either N, P, or K was omitted from the fertilizer, yields dropped approximately 1.5 tons per acre.

5—Nutrient deficiencies are distinct in pepper, with some symptoms being quite different from those on other plants.



### The Whole Truth—Not Selected Truth

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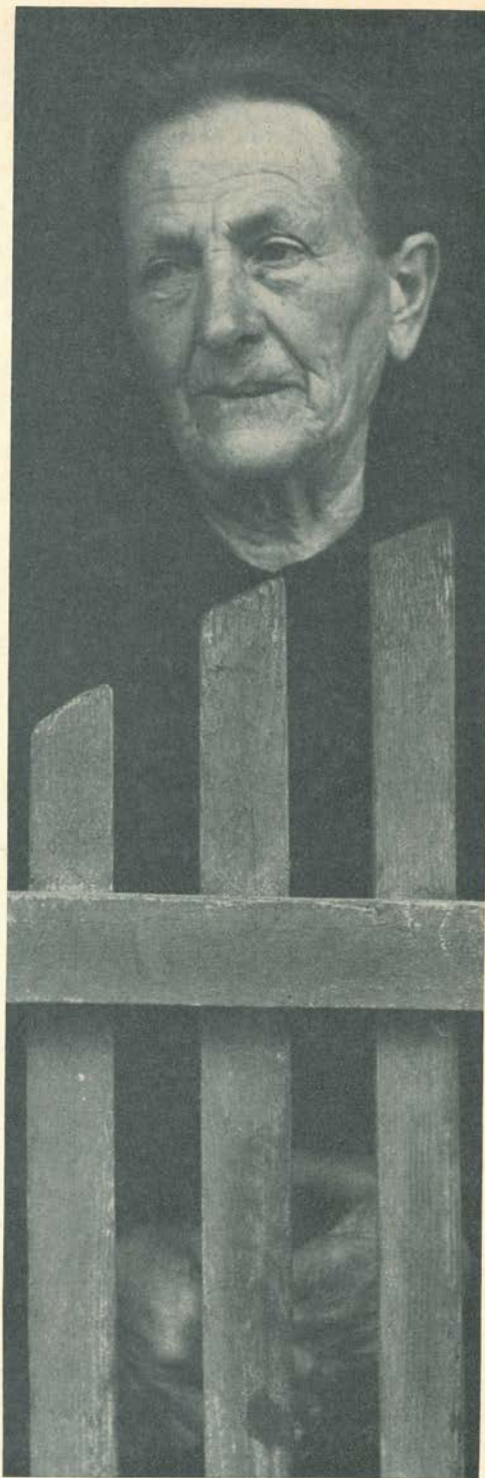
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**WOMAN OF THE EARTH**





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VOL. XLIII WASHINGTON, D. C., JANUARY-FEBRUARY 1959 No. 1

Another new year always meant . . .

## FARMERS' ALMANAC

*Jeff McIlmud*

(ELWOOD R. MCINTYRE)

**E**ARLIEST of many a juvenile remembrance, among my fleeting generation now grown old, are the two indispensable references on which our farms relied—the Bible and the countryfied, outdoor-lover's annual almanac.

The one gave us solace, guidance, and assurance through a world of sin and sorrow, to make us feel like a confident Christian on his puzzling journey beyond the delectable mountains into the promised land. The other gave us courage to face the storms and droughts of the months ahead, mix it with a touch of wit and wisdom, to learn again the significance of the sacred song: "Behold the Heavens, the work of Thy Fingers, the moon and the stars which Thou hast ordained—what is man that Thou art mindful of him?"

I always felt that the almanac and the scriptures belonged together somehow. Yet, my faith was shaken during the early days of sales pressures, when the zodiac man *with a flap in his belly* gave way to the woodcut of a man rescued from death by a generous partaking of suggested patent medicines.

It is not within the sphere of this essay to dwell on the stupendous collection of relevant and immaterial facts that adorn the pages of either the World Almanac or the popular Information Please. It is not my claim that the old-time almanacs equalled the modern tomes of technology. But I do claim they made better casual reading for the young and ambitious, as well as the elders.

Widest recognition in almanac annals in this country belong to Robert B. Thomas, creator of the *Farmers' Almanac*, read in the early 19th cen-



tury at New England firesides. Sharing a somewhat similar place for his weather charts and forecasts, Irl R. Hicks, the "storm prophet", later was regarded as a seer and a scientist combined. But other almanacs deserve comment for their original and picturesque appeal, or historic interest.

The early English settlements had a spate of forecasters and "philomaths" who peddled their cultural and celestial texts at Cambridge and Harvard College. Photostat copies of these old documents preserved in libraries include the philosophy of "ye scribes": Sam Danforth, 1646; T. S. Shepard, 1656; Sam Bradstreet, 1657; Nathaniel Chauncey, 1662; Sam Brakenburg, 1666; John Tulley, 1675-76, and John Foster, 1687.

Among the first to smarten up with jokes and use of a commercial sponsor was the *Farmers and Planters Almanac at Hagerstown*. Besides the usual monthly records, moon's phases, and weather hints, it carried samples of yeoman wit like these:

"The poor robin who has lost its mate takes a *bird's sigh* view of the world."

"Waiter, what kind of a pie is this?"

"Apple pie, sir."

"But there's no apple in it."

"Beg pardon, but we use *evaporated* apples!"

This Maryland almanac was tied in with ads for Woolridge fertilizers. Several letters from delighted devotees of their noted Kangaroo Komplete Kompond and Orchilla Guano claimed many converts in rural Pennsylvania, Virginia, Delaware, and Maryland. Analyses of the KKK brand also appeared over the signature of reliable Prof. W. P. Terry, Baltimore.

Causes, movements, ideas, and places were noteworthy reasons for launching almanacs. In the 19th century, the *Shaker Family Almanac* promoted Shaker Pills at 25 cents a bottle. Anti-slavery almanacs were printed by anti-slavery societies in Boston, New York, and Ohio through the Forties and Fifties. Then there were the Unitarian almanacs of 1852, the Whig almanac and Family Christian almanac, 1853, and the British clergymen's almanac of 1852, listing the bishops, deans, canons, chancellors, and deacons presiding in England and overseas. There were many hundreds of almanacs about towns and cities. There was a unique Bible Searching almanac published 65 years ago in London. Scriptural texts were printed in series with vacant lines below each to be filled in with the book, chapter, and verse. Medical purveying almanacs were numerous, such as those of Dr. Jaynes, Dr. McLean, and Dr. Herter, forerunners of the drug chain almanacs handed out free today.

Quite noteworthy was the *American Comic Almanac* of 1831, with "whims, scraps, and oddities." The publisher was Charles Ellms, at Court street and Cornwall, Boston. At his little shop he also sold "Juvenile keepsakes, childrens' books, slates, tape, rulers, folders, reticules, wallets, razor straps, and paste." His almanac sold in New England for 12½ cents per copy. He picked upon a startling year of heavenly activity to start his venture, for 1831 saw two eclipses of the sun and two of the moon.

As an opener, Ellms contrasted *farm life in pioneer times of 1732 with the ease and pleasure of agriculture in 1832*: "In 1732, man to the plow,



wife with the cow, girl tends the sow, boy works in mow. . . Then for 1832, man out on a blow, miss at piano, wife silk and satin, boy Greek and Latin."

He handed out technical talk too, like: "When crows yank up your corn, save replanting by dissolving 6 pennyworth of copperas and then steep your seed corn in it overnight. This cure is safe, the defense is sure."

On a page giving the medical lectures at Dartmouth, Brown, and Bowdoin colleges, there appeared a wood-cut showing two mean miscreants unearthing a coffin, with the title "resurrection men." No doubt this made readers shudder again over the dubious occupation of Burke and Hare of evil notoriety.

One almanac—the *Capital Almanac*—published in the late 1880's, was openly started to promote the infamous Louisiana Lottery, where the names of Gens. George T. Beauregard and J. T. Early were used to catch suckers. Capital prizes each month were awarded, with a special grand drawing once a year. "If the mammoth drawing of \$600,000 is won by a number ending in 531, then all tickets with their numbers ending in 31 will each get \$800."

We close this essay with a handful of incidents of lighter vein that were printed in some of the early almanacs we have scanned lately—with some doubts, perhaps, that they will get guffaws from this generation.

A woman in Lancashire, being told that candles had risen two pence a pound because of the war, said: "Dang it all. Are they got to fightin' by candlelight?"

A traveler along a road came to a spot where one man had another one down and was thumping him hard. The traveler shouted, "Let him up to have equal chance with you!"

To this the fighter replied, "If you had been to so much trouble to get him down as I have, you'd not be for letting him up so early."

The church warden of a New Hampshire parish asked a local tradesman repeatedly for his subscription toward the coming lectures at the church, asking him why he declined. "Because my wife reads me a better lecture every evening free!" the tradesman replied.

"Is my wife out of spirits," said John with a sigh, as her voice of a tempest gave warning.

"Quite out sir, indeed," said the maid in reply, "for she finished her bottle this morning."

A man testified in the House of Commons concerning conditions on the Isle of Man. "Is the population there much on the increase?" the witness was asked.

And he answered, "Very much, sir, since my living there."

An Englishman told an Irishman that he heard the devil was dead. Thereupon, the Irishman handed his informant a shilling piece saying, "In Ireland, we always give the child something when the parent is dead." ■

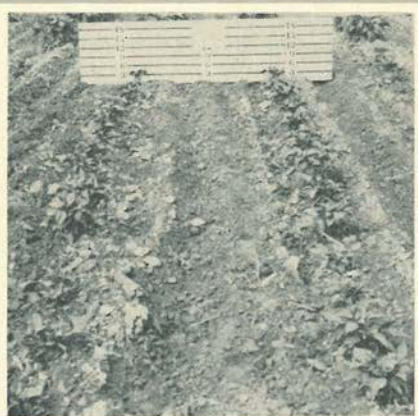




**A. NO NITROGEN**



**B. NO PHOSPHATE**



**C. NO POTASH**



**D. COMPLETE FERTILIZER**

## **BALANCED FERTILIZATION**

### **A STRIKING NEED IN PEPPERS AS IN OTHER CROPS**

On low fertility soils lack of any one of the major plant nutrients may limit pepper growth though the other two elements are adequately supplied. In A, B, and C one nutrient was left out while the other two were applied at 100 pounds per acre. In D; all three were applied at 100 pounds per acre. This is a striking example of the need for balanced fertilization.



# FERTILIZERS BOOST BELL PEPPER

By

M. B. Parker

J. E. Bailey

H. D. Morris

University of Georgia

**F**OR MANY years, bell pepper has been grown as a vegetable cash crop in the mountain area of north Georgia.

This crop continues to be grown primarily for the fresh market. In fact, almost all the pepper of this area was marketed in this manner until 1950.

At this time, around 1950, a commercial plant was established in the mountains to process mature or red peppers. Farmers under acreage contracts supply these peppers to the processing plant where they are diced and brined for later use in soup mixtures. Contract agreements have assured farmers of an annual market with a known price for red peppers.

The factors causing such a plant to



A good soil, ample plant nutrients, and plenty of rainfall are necessary to harvest 13 tons of red bell pepper per acre.



Four tons of lime to a low potash soil resulted in severe potash deficiency symptoms of pepper. Liming soils without applying adequate amounts of potash to pepper could become a serious problem.

## WHERE \$26 WORTH OF FERTILIZER INCREASED RETURN OVER \$400 PER ACRE



When fertilizer valued at \$26.00 was added to this bell pepper, the increased return per acre above fertilizer cost was over \$400.00.

be set up here were the *quality* and *yields* of pepper that could be achieved with proper management. *Yields of 10 tons per acre are not uncommon*, undoubtedly influenced by the amount and distribution of rainfall during the growing season. Average rainfall from May 15 to October 15 is *20.4 inches*, with almost half of it coming in the critical growth period of July and August.

Even with good moisture conditions, many growers fail to produce the potential yields. *Lack of adequate fertilization is probably one of the main reasons for this failure.*



Dr. H. D. Morris, professor of agronomy at the University of Georgia, teaches and researches in the fields of soil fertility and fertilizers. He earned his B.S. and M.S. from N. C. State, his Ph.D. from Iowa State.

### Fertility Work

The low yields obtained by some growers indicated a need for fertility work. So fertility research with pepper was initiated in 1954, continuing each year to date.

The main purpose of these experiments was to obtain data *for making fertilizer recommendations for pepper*. Treatments in the experiments consisted of rates of nitrogen, phosphate, and potash with a lime variable included in two of the studies.

### 1954 Test

The first test was conducted on an acid, highly fertile soil which had a pH value of 5.4. On this soil, pepper yields were not increased by fertilizer nutrients or lime. Mean yields of 10 tons per acre were obtained with and without fertilizer nutrients. Apparently the soil contained adequate plant nutrients to supply the pepper plants.



### 1955 Test

Results in 1955 on a low fertility, acid soil were quite different from those obtained the previous year. On this area, pepper followed corn and each crop received the same fertilizer and lime treatments. Increments of 0, 50, and 100 pounds of each of the fertilizer nutrients were tested with and without lime. Lime was applied at the rate of two tons per acre each year, increasing the pH value of the limed soil from 5.3 to 7.0.

Plant growth response to fertilizer was apparent very early in the growing season. A complete fertilizer was necessary to produce a healthy, vigorous, fast-growing plant. Leaf symptoms denoting deficiencies of nitrogen, phosphorus, and potassium were evident when the first fruits ripened.

Pepper yields were increased by N,  $P_2O_5$ ,  $K_2O$ , and lime (table 1). *Absence of potash limited yields more than the absence of nitrogen or phosphate.* This can be seen by comparing the increases in yield from 100 pounds per acre of each nutrient with lime. These increases in tons per acre were: N-3.4,  $P_2O_5$ -5.8, and  $K_2O$ -7.4. Without lime, similar but smaller increases were obtained by the additions of each nutrient.

In this test with lime, important increases were obtained from applications up to 50 pounds of N, 100 pounds of  $P_2O_5$ , and 100 pounds of  $K_2O$  per acre.

Without lime, yields were increased significantly only up to the 50-pound rate of N,  $P_2O_5$ , and  $K_2O$ .

Monetary returns from applying each nutrient was quite striking. *Of the three nutrients, the greatest economic return was obtained from applying potash.* The increased return from 100 pounds of  $K_2O$  that would cost about \$5.00 would be \$370.00 at the present price of peppers—in other words \$5.00 worth of potash meant \$370 more return in peppers.

Beneficial effect from lime was noted in plant growth and in in-

J. E. Bailey has been with the Georgia Agricultural Experiment Station since graduation from the University of Georgia in 1927. He is now Horticulturist and Superintendent of the Georgia Mountain Experiment Station, where he has been located since the station was created in 1930.



creased pepper yields. On lime-treated plots, the plants were more thrifty and much greener than plants on unlimed plots. These differences were evident on the plots receiving no nitrogen or phosphate.

Applying lime to a soil supplied with moderate amounts of commercial fertilizer was decidedly beneficial, but lime *without* fertilizer was unprofitable (see table 1).

Response to lime was most noticeable when adequate amounts of phosphate and potash, but no nitrogen, were applied. In this treatment, lime increased the yield 2.8 tons of pepper per acre. *Lime was not effective in increasing yields when potash treatments were less than 100 pounds per acre.* At the lower rates of potash, adding lime accentuated the potash deficiency symptoms of the pepper leaves.

To determine whether lime was affecting the K uptake by the plants, samples of pepper leaves were harvested just before frost and analyzed

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for potassium. Leaves from plants grown on the limed plots were found to contain only about 50% as much potassium as leaves of plants from the unlimed plots receiving the same potassium fertilization (table 2).

Potassium content of the pepper leaves was increased by each increment of potash applied, while lime greatly reduced K uptake by the pepper plant. However, there was no correlation between K content of the leaves and yield, because of the influence of lime on potassium absorption.

Luxury consumption of K by the pepper plant is shown by comparing the treatment receiving 100 pounds each of N,  $P_2O_5$ , and  $K_2O$  with and without lime. This treatment with lime had an average K content in the leaves of 2.27 percent and produced 11.71 tons of pepper, while without lime the same treatment had 4.62 percent K in the leaves with a production of 9.48 tons.

### 1956 Test

In 1956, no response in pepper yields was obtained from fertilizers on a low fertility soil. Early in the growing season visible increases in plant growth from fertilizer were evident, but these differences were not reflected in yields. The average yield

for this test was 8.4 tons per acre. An outbreak of leaf diseases which was not uniformly distributed over the experimental area may have caused the lack of response to fertilization.

### 1957 Test

Pepper yields were increased by adding complete fertilizers on a low fertility soil in 1957 (table 3)—an increase of almost 2.9 tons per acre over the control crop. When either nitrogen, phosphate, or potassium was omitted from the fertilizer, yields were reduced approximately 1.5 tons per acre.

In this test, the lack of adequate moisture during July and August was quite evident. Only half the normal rainfall (5 inches) was recorded in this two-month period when most of the pod development occurs. This lack of moisture decreased pepper yields and shortened the harvest period.

### Fertilizer Affects Early Maturity

Some nutrients affect early maturity as well as total yields of pepper. *Phosphorus appears to influence early maturity more than potassium or nitrogen.*

Each year, regardless of soil fertility, lack of phosphate retarded the maturity of red pepper. But this effect was more noticeable in 1957

Table 1. Bell Pepper Response to Fertilizer and Lime on Congaree Silt Loam, 1955

Pounds per acre			Tons of marketable red pepper per acre		
N	$P_2O_5$	$K_2O$	Limed	Unlimed	Increase from lime
0	0	0	2.51	2.59	-.08
0	100	100	8.28	5.44	2.84
50	100	100	10.78	9.63	1.15
100	100	100	11.72	9.48	2.24
100	0	100	5.93	4.43	1.50
100	50	100	9.68	7.94	1.74
100	100	0	4.37	4.20	0.17
100	100	50	8.15	8.79	-.64
		Mean	7.68	6.56	1.12



than in previous years. To determine the effects of phosphate on early maturity, yields at each harvest affected by  $P_2O_5$  treatments are shown in Table 4.

At the first harvest, yields generally increased as the rate of  $P_2O_5$  increased, but at the last harvest the trend was reversed. The 120 pounds  $P_2O_5$  per acre produced the highest yield at the first harvest and the lowest yield at the last harvest.

*In pepper production, phosphate is more important for promoting the early development and maturity of the plant than in increasing total yields.*

Some indication of this phosphate effect can be seen by comparing the yields of the control with the highest rate of phosphate treatment at the end of the second harvest (table 4). At that date there was a difference of 2.4 tons in favor of the phosphate treatment. Yet, for the entire season the difference between the treatments was only 1.4 tons. Much of this early difference was reduced during the last three harvests when the control consistently outyielded the phosphate treatment.

#### Deficiency Symptoms Under Field Conditions

In the absence of adequate amounts of plant nutrients, pepper yields can be reduced without visible deficiency symptoms. On the other hand, de-

Table 3. Influence of Fertilizers on Yield of Bell Pepper on State Loam Soil, 1957

Pounds per acre			Marketable red pepper tons per acre
N	$P_2O_5$	$K_2O$	
0	0	0	3.05
0	120	120	4.33
120	0	120	4.49
120	120	0	4.42
120	120	120	5.91

ficiency symptoms may develop without a corresponding decrease in yields. *Pepper is more sensitive to fertilizer elements, especially potassium, than many other crops.* When these deficiencies become acute, the individual symptoms are distinct and easily recognized. Some of these deficiencies on pepper show symptoms quite different from those observed on other plants.

#### 1 Nitrogen

Nitrogen is a limiting element for plant growth on almost all of the soils in this area. Yet, on many of the soils, adding this element does not increase growth and yield of pepper nearly as much as phosphate and potash.

The first indication of nitrogen deficiency is a lack of vigor in the growth of the pepper plant. Leaves of affected plants are *small* and *narrow*

Table 2. Influence of Lime and Potash on Yield of Pepper and K Content of the Leaves, 1955

Pounds per acre			Limed		Unlimed	
N	$P_2O_5$	$K_2O$	K	Yield	K	Yield
			%	tons	%	tons
100	100	0	0.53	4.37	0.99	4.20
100	100	50	0.93	8.15	2.66	8.79
100	100	100	2.27	11.72	4.62	9.48



Table 4. Effect of Rates of Phosphate on Early Maturity of Bell Pepper, 1957

Pounds per acre $P_2O_5$	Tons per acre by harvests					Total yield
	First 8/23	Second 8/28	Third 9/5	Fourth 9/10	Fifth 9/24	
0	0.20	0.42	1.65	1.02	1.20	4.49
40	0.71	1.06	1.08	0.99	1.04	4.88
80	0.90	1.22	0.99	1.16	0.86	5.13
120	1.84	1.22	1.25	0.88	0.72	5.91

and lack the normal dark-green appearance. Gradually the green color in the leaves fades to light green and finally to yellow. The entire surface of the leaves is yellow and may become golden in the latter stages.

In the acute stage, pods may fail to develop to normal size and may not ripen properly. Affected plants remain stunted in comparison with healthy plants and have a poorly developed root system. Even under extreme deficiency conditions, the plants have a normal amount of foliage.

## 2 Phosphate

Early in the growing season an adequate supply of phosphate is more important than nitrogen or potash. Without adequate amounts of soil or fertilizer phosphate the plants fail to grow and develop properly.

After setting plants on mineral-deficient soils, the lack of phosphate is usually recognized as the first nutrient deficiency.

Phosphate deficiency of pepper is first recognized by the *stunted type of growth*. Affected plants lack normal vigor. Normally the foliage symptoms from lack of phosphate are not very distinct.

When grown in a soil moderately well supplied with nitrogen and potash, leaves of plants suffering from phosphate deficiency have a tendency to be a *darker green* than those of

normal plants. This abnormal green color has been explained as probably due to an increase in the chlorophyll concentration in the slow-growing vegetative tissues.

Leaves of deficient plants are small and narrow, but the plant may grow out of this condition and appear normal toward the end of the growing season. As the size of the plant increases, the leaves tend to return to normal color.

## 3 Potash

A pepper plant must be continuously supplied with potash for normal growth. In north Georgia, potash appears to be more important for pepper production than nitrogen or phosphate. Plants receiving no potash in these tests exhibited distinct and clearly defined deficiency symptoms (*see front cover*). The symptoms discussed below were associated with plants produced with minus potash but this did not occur on plants supplied with potash.

Dwarfing is the first symptom observed. This reduced size is due to the short internodes.

Leaves of the affected plants assume an *abnormally dark green* to almost blue color. This symptom is especially common in plants adequately supplied with nitrogen and phosphate. Increase in chlorophyll concentration in the slow-growing vegetative tissues



probably causes the abnormally dark green color.

Lower leaves are normal in width and length, but upper leaves are small and compactly arranged on the stems. As the season progresses, leaves nearest the terminal bud of the affected plants become increasingly smaller. Leaf chlorosis develops and appears first on those nearest the terminal bud.

Interveneal tissues of the uppermost leaves become chlorotic first, with the midrib and veins remaining green. This condition spreads downward to the older leaves, until finally all the leaves appear chlorotic with the midrib and veins remaining light green.

Then the tissues between the veins of the leaves become yellow, necrotic areas. Necrosis spreads toward the petiole, causing premature shedding of the leaves. Affected leaves have a tendency to roll upward toward the midrib, with a rusty appearance similar to "rust" on cotton leaves.

Toward the end of the growing season plants may be almost completely defoliated. This "naked" condition exposes immature fruit to direct sunlight, causing injury from sun scald.

These visual deficiency symptoms have been attributed to potash hunger because of the consistent association in this study of the symptoms with plants receiving no potash and the lack of these symptoms on plants receiving potash.

### Summary

Results from fertilizer experiments with bell pepper showed outstanding

yield response on some soils, while on others very little or no response. But, in every experiment the application of phosphate was necessary for early maturity.

For assurance of crop success, the grower should apply lime and fertilizer to meet the necessary requirements. The best guide for determining these requirements is a *soil test*. Lime should be applied to bring the soil pH value up to the 6.0 to 6.5 range. One to two tons of limestone per acre usually will bring an unlimed north Georgia soil into this range.

Adequate fertilizer nutrients must be available to the pepper plant for it to make good growth and produce high yields. On high fertility soils, very little commercial fertilizer may be necessary since most of these nutrients may be supplied from the soil. But on the low fertility soils, commercial fertilizer must be applied in order to obtain good yields.

Fertilizer requirements for bell pepper on low fertility soils can be met by:

**1** Using 80 pounds of nitrogen per acre, one-half to two-thirds applied as side dressing.

**2** Applying 120 pounds of P205 and K20 per acre in the row before setting the plants.

*The above needs may be supplied by distributing 1,000 pounds of a 4-12-12 fertilizer in the row before setting the plants, and following this with 40 pounds of nitrogen as a side dressing when the first fruits set. ■*

---

### WATCH POTASH SHORTAGE

"If legumes (such as clovers and alfalfa) and grasses are growing together, a shortage of potassium may lead to the reduction or disappearance of the legume without the occurrence of any severe deficiency symptoms," R. F. Reitemeier warns in the 1957 *Yearbook of Agriculture*.

---



**1** Maximum fertilization to produce good roadside turf quickly, that will then serve as long-term ground cover.

**2** Provide an adequate supply of nutrients for the least fertile soil in the state, county, or soil group concerned.

**3** Nearly all soils are deficient in nitrogen supply for desired grass establishment.

**4** Wherever phosphorus is deficient, it is *most needed* mixed into the root-zone before planting.

## PRINCIPLES FOR

**5** A suggested standard is 100 lbs. each of N,  $P_2O_5$ , and  $K_2O$  as a seed-bed application.

**6** Get a soil test before liming.

**R**APIDLY increasing population and the need for more and faster communication facilities are constantly increasing the demand for more and better highways. The present Federal Highway program is a response to this pressure. The magnitude of this great project requires several levels of problem solving—national, state, and district.

Throughout highway construction, tremendous improvement in equipment and techniques has been achieved. The ability to utilize mulch, seed, sod, sprig and to fertilize effectively has been appreciated not only by the highway user, but by the contractor-builder as well.

### Early Turf Cover Essential

What can be more expensive than to build culverts, stream channels and diversion ditches to exacting specifications, then have them a double loss as they fill with eroded soil which was needed at the initial site? The cost of repairing any washout or failure, even after one heavy rain, may exceed the

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This report was prepared by the American Road Builders Association Subcommittee on Fertilization and Mulches in cooperation with the National Plant Food Institute Committee on Roadside Fertilization. It was edited by W. H. Daniel, Department of Agronomy, Purdue University.

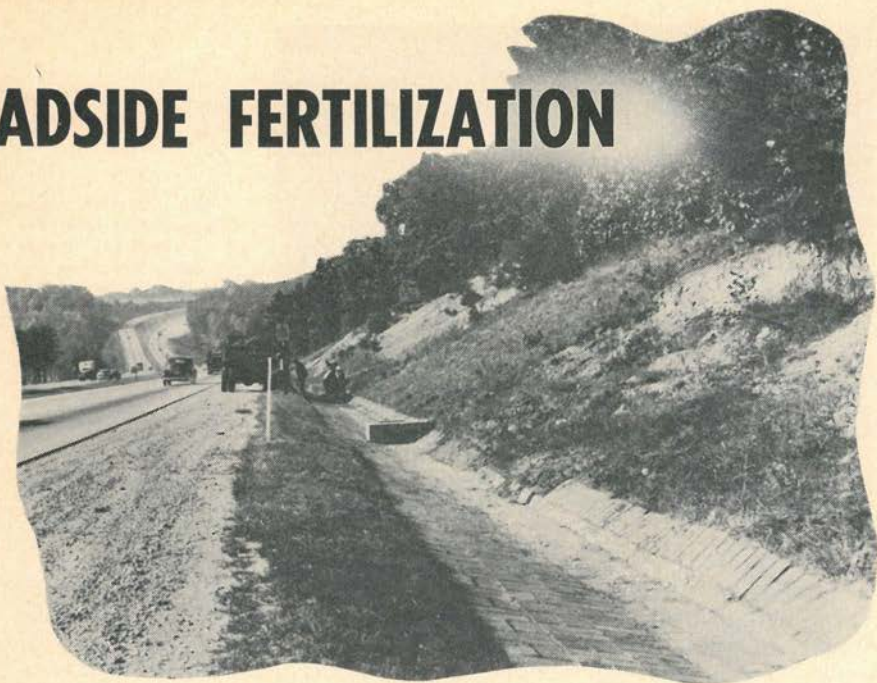
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# ROADSIDE FERTILIZATION



A bank once covered with vegetation loses ground and erodes because the crop was not kept in vigorous growing condition with fertilizer. Expense of cleaning crew with truck could have been saved by timely fertilization, costing little.

original cost of establishment. So roadsides, which may vary from one to five percent of the total cost in highway construction, need good turf foremost for early erosion control and engineering protection.

*THUS, THE FIRST PRINCIPLE IS: MAXIMUM FERTILIZATION IS NEEDED TO PRODUCE GOOD ROADSIDE TURF QUICKLY, WHICH MUST THEN SERVE AS LONG TERM GROUND COVER.*

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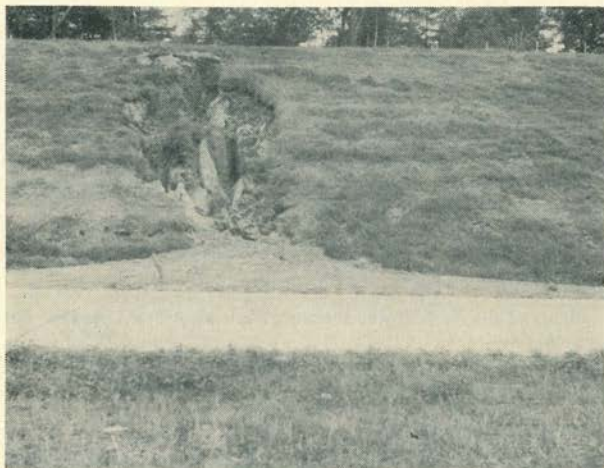
Here is erosion within thin grass sod cover due to inadequate fertility for dense turf. Even this can be improved by maintenance fertilization.

### Why is Fertilization Needed?

Fertilization saves time in developing quicker and better ground cover by making sure that the plant has plenty of nutrients. In general, the higher the fertility, the better the cover, and the fewer weeds infesting the area. Current roadbuilding practices require that large quantities of soil are moved in making cuts, overpasses, fills and ditches. This exposes mostly subsoil which is much less fertile than the topsoil. Yet, even the original topsoil may not be fertile. For example, of the 36 soil groups within Indiana, soil tests show 40% are low in phosphorus and 47% low in potassium.

Soils higher in clay have more storage capacity for nutrients and water than do sandy soils. Topsoils have an accumulation of decaying plant matter and usually have a more granular structure and a higher nutrient content than subsoils.

In the building of new roads, the original topsoil, unless stockpiled, is not present on the final graded surface. On most projects, only the topsoil



Washouts are costly. Maximum fertilization would have produced stable cover quickly.



Here a faulty cover crop lets light plastic clay subsoil slump into the gutter. Such soil demands careful soil preparation, often cheaper than ditch upkeep.



salvaged on the project is ample for reapplication to critical areas and this, after spreading is blended into subsoil rather than left as a separate layer. Topsoil is not applied on steep cut slopes, for slumping and slipping may occur whenever topsoil is saturated with water. The scraping, hauling, stockpiling, and re-spreading of topsoil is costly (ranging from \$0.50 to \$1.50 per cu. yd., and 4" topsoil is 500 cu. yds. per acre). Much heavier and repeated use of fertilizer would be a money saving alternative. But, in deficient subsoils a favorable rootzone supply of nutrients, particularly nitrogen, is imperative for satisfactory turf.

**THE SECOND PRINCIPLE IS TO PROVIDE AN ADEQUATE SUPPLY OF NUTRIENTS FOR THE LEAST FERTILE SOIL IN THE STATE, COUNTY, OR SOIL GROUP CONCERNED.**

#### **What Nutrients Need Adding**

Plants contain over 35 chemical elements. Many of these are called trace, or minor elements, because so little is used or needed. Others are used in larger

Good engineering is wasted when slope cover is lacking.





amounts, and often are present in adequate supply. These include: sulphur, magnesium, calcium, etc.

Commercial fertilizers may carry some of the above, but primarily they supply the three most needed elements—nitrogen, phosphorus, and potassium.

*Nitrogen*—Nitrogen encourages fast growth, a dark color, leafy growth, and a dense ground cover. Its absence is obvious through yellowing, sparse cover, and poor growth after germination. Nitrogen is subject to rapid utilization by plants and is not retained well in the soil. Leaching, plant use, and soil micro-organisms may quickly reduce its availability.

**THE THIRD PRINCIPLE IS: NEARLY ALL SOILS ARE DEFICIENT IN NITROGEN SUPPLY FOR DESIRED GRASS ESTABLISHMENT.**

*Phosphorus*—Within each seed there is enough phosphorus to get a seedling started, but, then, young plants MOST need phosphorus to develop new cells and to make rapid growth. Seedbed preparation offers the best opportunity for adequate phosphorus incorporation, for roots expand rapidly *ONLY* into soil areas having above minimum phosphorus.

**THE FOURTH PRINCIPLE IS: WHEREVER PHOSPHORUS IS DEFICIENT, IT IS MOST NEEDED MIXED INTO THE ROOT ZONE BEFORE PLANTING.**

*Potassium*—This is used in large quantities as a balancing and regulating element in plants. Also, it is leached and fixed gradually in the soil, so potassium needs regular replenishment.

### Facts About Fertilizers

The label may read 16-8-8, 15-15-15, 8-16-16, etc. The first figure always refers to the percentage of nitrogen (N) by weight in the fertilizer formulation; the second is the amount of phosphorus (expressed as  $P_2O_5$ ), and the third is the percentage of potash ( $K_2O$ ).

When buying fertilizer you buy actual pounds of these nutrients. High analysis fertilizers cost more per ton, but less tonnage is required, so handling cost may be lower. For example, 2 tons of 15-15-15 equals 3 tons of 10-10-10, or 1 ton of 20-10-10 equals 2 tons of 10-5-5 in amount of nutrient supply. Many combinations of mixed fertilizers are on the market as solids or liquids for a variety of application requirements. In Indiana, for example, over 50 companies produce fertilizer, of which over 40 distribute a 1-1-1 ratio fertilizer, such as 12-12-12.

Generally, a pound of available plant food is equally efficient whether used as a dry or liquid form. For example, 100 lbs. of 8-8-8 is equal in plant food whether applied as a liquid (approx. 10 gals.) or in a pelleted, granular, or other solid or dry form. With hydroseeding methods, water is used to dilute fertilizers and seed for rapid spreading with efficiency and saving in time.

### How Much to Use

The key values are the total pounds per acre of each element required. Where fertilizer is worked into the root zone, or when a mulch is used, then loam soils can utilize and store for plant use at least 100 lbs. per acre each of N— $P_2O_5$ — $K_2O$ . This would be equivalent to about 20 lbs. per 1,000 sq. ft., 180 lbs. per 1,000 sq. yds., or 870 lbs. per acre of 12-12-12, or its equivalent. Even for sandy or gravelly soils with low nutrient holding capacity, use of one-half this amount is minimum. On exposed cut slopes in Georgia, Hendrickson had best results with 200# N—400#  $P_2O_5$ —200#  $K_2O$  per acre in slope erosion plantings.

The increasing availability of ureaforms(UF), a source of long-lasting con-



Grass grown on properly limed and fertilized soils reduces erosion, develops a sod quicker and can crowd out weeds. It will be longer lived and can carry a heavier load without breaking through, under emergency traffic use, as well as recover more rapidly from the effects.

trolled-release nitrogen, and their incorporation into mixed fertilizers, offers the possibility of much higher application rates for initial seedbed fertilization. This would reduce the severe need for supplemental nitrogen feeding soon after seedling emergence, and would improve turf cover. Research by De France in Rhode Island, Musser in Pennsylvania, Daniel in Indiana, and elsewhere has shown that ureaform nitrogen is ideally suited for seedbed use in that a single heavy application carries the grass on to established sod. Since longer nitrogen release and steadier feeding is expected, rates of 300—100—100/acre would be standard.

Many turf fertilizers are being offered on the market with approximately 50% of nitrogen as UF. For these, rates of 200—100—100/acre are suggested. In Rhode Island, De France used 350—175—175 lbs. of N,  $P_2O_5$ ,  $K_2O$  respectively, as complete fertilizer which contained more than 50% of the nitrogen as ureaforms.

On slopes where mixing is impractical, under sod, or where hydraulic fertilization and seeding, plus mulching is used, surface applications up to 100 lbs. of each element should be standard.

**A FIFTH PRINCIPLE—SUGGESTED STANDARD IS 100 LBS. EACH OF N,  $P_2O_5$ , and  $K_2O$  AS A SEEDBED APPLICATION.**

### Acid Soils Need Lime

Lime, to be most effective, is best mixed into the surface soil. Calcium in lime serves as a nutrient, changes the soil to a desirable pH for plant growth, improves the physical condition of the soil and regulates the release of other elements essential for plant growth. Many soils do not need lime, so a soil test should always be secured to determine the desired rate. Since the interpretation of tests is based on research within each state, soil samples should be sent to a laboratory in the area. Agricultural limestone is widely available.

For convenience and handling ease with hydraulic equipment, hydrated lime (75% as many pounds as agricultural lime) may be spread, but separately from fertilizers. Below are two examples of hydroseeding proportions for 5,000 sq. yds. of cut slopes—

Western Pennsylvania example		Ohio, example only	
Water 1,000 gals.	8,000 lbs.	Water 1,000 gals.	8,000 lbs.
Ground limestone	4,000 "	12-12-12 fertilizer	950 "
8-16-16	550 "	70% Ky. 31 fescue	} 135 "
Ryegrass seed	45 "	20% Ky. bluegrass	
Crown vetch seed & inoculation	15 "	5% Redtop	
		5% Alsike clover & inoculation	

**A SIXTH PRINCIPLE—GET A SOIL TEST BEFORE LIMING.**

### Mulches Help Guarantee Results

Mulching protects the investment in grading, seeding and fertilizing. With the improvement in machinery for mulch applications, plus asphaltic binding,



mulching for quick and more uniform turf establishment has become standard. Mulch assists in reducing freezing and thawing and the detrimental effects of weather variations on seeding establishment and early survival. It permits much more latitude in the time of grade stabilization and seeding with assurance of successful results.

In Connecticut, 5 oz./sq. yd. of open mesh burlap is used as mulch on waterways. In the Midwest, sod is often used in ditches. In Florida, damaged "tobacco cloth" is pegged down as mulch on steep slopes. Mulch use from 1-2 tons of straw or hay per acre is reported, depending on application equipment. Ohio permits four mulching methods, but favors 1.25" loose mulch (1.25 tons dry straw) sprayed with 100 gals. specified asphalt emulsion as the straw leaves the mulch blower.

*IN GENERAL, THE USE OF MULCH REQUIRES, AND ALSO PERMITS, A MUCH HEAVIER USE OF FERTILIZATION WITH SAFETY.*

### Fertilize to Maintain Good Turf

Plant usage, fixation in the soil, leaching, and erosion make annual fertilization after planting desirable on grass sods. On slopes where legumes—such as crown vetch—predominate, only phosphorus and potash would be used if cover is thin. An application of fertilizer at seeding time is not enough to keep turf dense year after year. Nitrogen is the most needed in maintenance, and a complete fertilizer high in N, such as 18-6-6, 12-6-6, or 16-8-8, should be most efficient. Few have been shown through demonstration or example the improvement value of maintenance fertilization. Landscape supervisors within each state are challenged to continually test and demonstrate fertilizer response on problem areas as a means of acquainting their organizations with the benefits accrued. ■

## SILAGE REMOVES MUCH POTASH—TEST SOIL

Ray Pavlak of Deerfield, Wisconsin, had three fields of muck soils that had been cropped continuously to corn for 8 years. Each field had received around 1200 pounds of muriate in this period, with starter being used each year. Fields A and B were not doing so well, so he had the soil in all fields re-tested (below):

Soil Test Values—Wisconsin Soil Testing Lab.

Field	N	P	K	pH	Cropping for 8 years
A	400	30	95	5.6	Silage removed every year
B	375	60	210	5.7	Silage removed 4 times
C	375	80	400	6.2	Only corn grain removed

This illustrates how many nutrients, particularly potash, are removed by silage. It stresses the need for soil tests in each field.





Eden Valley, Minn.—Oscar Ruprecht says soil testing is a real “private eye” for solving the mysteries of low corn yields.

A soil test this year so precisely named the “culprit”—low potash—in one of his fields that dairy farmer Ruprecht found he could raise his corn yields by 50 percent or more through use of this one fertilizer nutrient.

He made the finding through some on-the-farm “experimenting” with help from Howard Grant, Meeker county agent; Lowell Hanson, University of Minnesota extension soils specialist and John Grava, supervisor of the University soil testing laboratory.

Here was the situation: When Ruprecht came to the farm four years ago, he felt he was lucky to get 30 bushels of corn per acre. Since then, he’s been using 150-200 pounds of 5-20-20 per acre, and raised yields to 50 bushels per acre. But he still wasn’t satisfied. So this spring, he sent a soil sample to the University for testing.

*“The test showed an alarmingly*

*low potash level,”* he recalls. “It was so low, that it showed the field needed 80 or more pounds of this nutrient per acre alone. Phosphorus, on the other hand, wasn’t especially short, the test showed.” If this were accurate, Ruprecht knew it meant that 5-20-20—which contains 5 pounds nitrogen, 20 pounds phosphate and 20 pounds potash in each

## A REAL PRIVATE EYE

100 pounds—wasn’t the right mixture. It would contain too much phosphate and not enough potash.

Ruprecht and Grant both figured some more checking was needed. So they got Hanson’s help in setting up a trial to see if the soil test was really telling the truth. They compared three different rates of phosphate, with as many rates of potash.

These were the results: Plots getting no potash yielded only 43 bushels per acre, even when 100 pounds of nitrogen and the same amount of phosphate was applied. But where Ruprecht applied 80 pounds of potash, yields were nearly 70 bushels per acre—regardless of whether any phosphate was applied or not.

A potash rate of 160 pounds per acre raised yields to 82 bushels per acre, but the increase wasn’t enough to make such a high fertilizing rate pay.

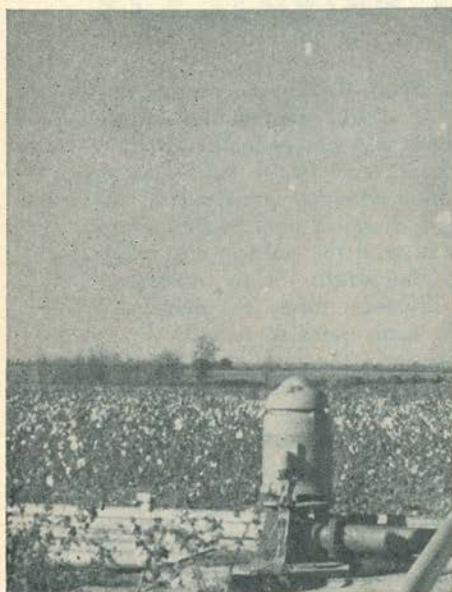
Ruprecht’s conclusion is clear. “There’s no longer any doubt that the soil test was right all along,” he says. “All summer, you could see that the corn that didn’t get any potash was way behind the rest. And the ears from the no-potash plot are small and nubby.”

As a result, Ruprecht is sold on soil testing as a way to gauge soil needs. “Without testing, you may be wasting your fertilizer money,” he explains. ■





Second irrigation of peanuts. Scott usually waters 5 to 6 times.



Irrigated cotton at harvest



Cover crop of rye and vetch on peanut ground, cross-fenced to prevent overgrazing.

In 1940, Barton Scott bought a farm in Caddo County, Oklahoma, where he grew up as the son of a tenant farmer. It was an 80-acre operation. Although he had never been able to secure college training in agriculture, he listened carefully to the college specialists—combining their advice with his own commonsense.

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## “I KNOW.

Today, he operates a 1,120-acre farm business—growing peanuts, cotton, wheat, and grain sorghum. He operates four irrigation wells. Recently he was invited to speak to a Fertilizer Conference on the campus of Oklahoma A&M College. What he had to say is worth sharing with our readers here.





# FERTILIZER PAYS

The Barton Scott home 3 miles south of Binger, Oklahoma

**I'M A FARMER WHO USES IT."**\_\_\_\_\_

**By Barton Scott**

**T**HE FERTILIZER we use should add to the soil—in *proper balance*—the nutrients our soil lacks. I have found it pays to use a chemical soil test to determine what my soil needs.

Time and again, soil tests have pointed out that my cropland needed nitrogen, phosphate, and potash. Through advice from the official agricultural advisors in my area, I learned that the amount I needed depended on two things: (1) how much nutrient the crop will take out, (2) how much nutrient I already had in the soil.

I decided I should know what these

three elements—nitrogen, phosphate, and potash—added to my soil, if I was to get maximum results. Through practical farming experience and care-

Mr. Barton Scott is a well known Oklahoma farmer. He is a director of the Southwest Peanut Growers Association and chairman of the Binger School Board. He has been active in the Farm Bureau and Farmers Union. He served as a delegate to Washington on peanut legislation.





ful guidance from the agricultural workers in my state, I have learned these things:

### . . . About Nitrogen

You can save a dime and lose a dollar when you skimp on nitrogen for your crops. How *fast* your crop grows depends more on nitrogen than on any other nutrient. It takes phosphorus for young plant cells to divide to make new ones, but without nitrogen there would be nothing to divide. It takes phosphorus and potash to make stiff straw and stalks, but *without nitrogen there would be no stalks*.

I've learned it takes more careful management to use nitrogen efficiently than it takes for either phosphate or potash. You've got to maintain the nitrogen supply in the soil. And you've got to make sure your crops have the nitrogen when they need it during the growing season.

Stockpiling nitrogen in the soil means stockpiling organic matter. And I've learned that's next to impossible on light, sandy soils—like I have. Even if you can stockpile organic matter, you must regulate its release so your crops can use it when they need it most.

I've learned that when nitrogen is in a form crops can use, you have a big job of keeping it in the soil. You have to watch out about it moving up and down with soil water. It'll leach out with drainage water, if you don't watch out. And in a dry spell, it may collect in dry surface soil, where crops can't use it. So, to maintain enough nitrogen, you should be constantly adding organic matter in the form of fertilizers, crop residues, manure, green manure crops, legumes, and sod crops.

No soil test, the specialists have shown me, will tell you how much nitrogen will be available to your crop during the growing season. A soil test will tell you how much nitrogen there is at the time the test was made, but a week later the situation

may be entirely different. So I have found the best measurement for nitrogen is an estimate based on the amount of organic matter in the soil.

The best way to tell when a plant needs nitrogen is to watch for the yellowish green color of the leaves. I have found on my farm that most of the soils need a little extra nitrogen, either because there is not enough total nitrogen in the soil or because there is not enough at certain times during the year. It pays to use commercial nitrogen fertilizer.

### . . . About Potash

Shortchange your crops on potash and you fool no one but yourself. Talking with my county agricultural workers and specialists from the college up at Stillwater, I have learned that potash, more than any other nutrient, *builds* your plant.

It is the *regulator*, they say, that introduces elements to each other in the plant so those elements can form compounds and be carried from one part of the plant to another.

One of the most interesting set of facts I have learned from these specialists is the function of potash in the plant. Apparently, they don't know everything yet about the working of potassium in the plant, but they do know enough to make these interesting points:

1—Plants need potassium before they can build chlorophyll, an element they must have before they can use the free nutrient from the air, carbon, hydrogen, and oxygen. These nutrients compose over 90% of the weight of plants, they say.

2—Plants must have potassium to make starches, sugars, proteins, vitamins, and cellulose.

3—Plants with enough potash use less water. This helps in droughts. I've noticed this fact in my farming during dry spells. My crops that had plenty of potash didn't seem to suffer as much as the others from the drought.



4—Plants will make better use of nitrogen when they have plenty of potash. If you want to see that proved, grow a high-nitrogen grass pasture and about the second year add potash to the treatment.

5—Plants must have potassium before they can transport the starches, sugars, and other energy foods from the leaves, where they are made, to the roots and other parts of the plant, where they are needed.

I try always to remember that plants can use only the *available potash*. Most soils have large amounts of *total potash*, but only small amounts of *available potash*.

I have also found you will get more from your potash dollar on the heavy soils. They are more able to fix the potash to small particles of clay and hang on to them when the crop does not need them. Sandy soils will not fix potash as easily, so its better to fertilize more often on such soils.

In my opinion and experience, absolute top yields require about 300 pounds of potash per acre. Potash has been taken for granted on many farms in many areas because we once thought the stockpile in the soil would last for generations. Lands we once thought would never need potash are showing a profit from its application.

*In my judgment, we can no longer overlook the need for potash on our crops.*

### . . . About Phosphorus

Through publications, specialists, and various meetings, I have noticed how they emphasize that seeds are rich in phosphorus. They say this is no accident. From the first minute of germination until the final harvest, plants need a continuing supply of phosphorus.

According to the experts, plants need phosphorus for five main reasons: (1) *To make new cells*, (2) *to make complete protein*, (3) *to build root systems*, (4) *to form the flower*

*parts and the pollen to fertilize them*, and (5) *to be able to use the nitrogen they get from the soil and other sources*.

I have found that when there is just enough phosphate in the soil to establish the plant, you will get a good stand but the growth will be slow. On such crops, top dressing will give you startling results. If you want phosphorus to really work for you, be sure there are enough of the other plant nutrients, too.

The specialists explain that phosphorus is a nutrient that does not move around in the soil or in the plant. Plants get phosphorus by sending their roots out to find it. They explain that in every good soil there are about 4,000 to 6,000 pounds of soil microbes. These microbes will use from 80 to 120 pounds of actual phosphorus for their bodies. There are so many of these microbes and they are so widespread that they can get the phosphorus before the plant roots can pick it up. That is why a regular soil test is so important.

When your soil test reads high, there will be between 100 and 125 pounds of available phosphate per acre. If you want the last ounce of production you should have about 200 pounds of phosphate per acre available to your plants. You can build up this amount by putting it all on at once or you can use more than enough for your crop and build it up gradually.

If you will keep your soil level high in phosphorus, give your crop extra phosphorus when it needs it and keep the supply of phosphorus in balance with the other nutrients the crop needs, you will likely get a good and profitable yield.

### . . . About Cotton

Two major crops I grow on my farm outside Binger, Oklahoma, are cotton and peanuts.

I have found it pays to use fertilizer under cotton. I believe this



would be true in all areas of the Southwest where adequate rainfall or irrigation can maintain continuous growth. There are many examples in my community where fertilizer is used to increase yields and profits.

Cotton uses plenty of plant food, like all other crops, and this plant food must be returned to the soil. This is only common sense when you think of the amount of plant food that erosion, leaching, and cropping remove from the soil.

Because of low rainfall, we thought for a long time that fertilizer would not pay in the Southwest. On some of the heavier soils, we have found that you can help the land hold more water by fertilizing the legume crop in the winter and plowing this under in the spring.

Another good example is to plant a legume, fertilize well, and rotate with cotton. This not only increases the water-holding capacity of the soil but greatly increases the fertility.

I have always realized the greatest profit from fertilizing cotton when the price is good. It is hard to make a profit under my operation when the price of cotton falls below 30¢.

With a reduced acreage planted to cotton on my farm, or any farm, I believe, *it is all the more important that fertilizer be used to increase the acre-yield and thus reduce the per unit cost of production.* It doesn't take a college agronomist or economist to understand that. Just grow a few crops and try to sell them, and you can understand *firsthand*.

Over the years, erosion has been the greatest thief of plant food elements in the soil. On sloping lands, this loss has been so great that the land can no longer produce a profitable yield, and the per unit cost is forcing such land back to grass.

But if it was necessary at some time in the future for this land to go back to production, most of it could be used through *proper fertilization and land practice program*.

In my deep sandy soil, I have found that leaching, along with erosion and cropping, have robbed the fertility. Since the American Potash Institute estimates that each bale of cotton takes 65 pounds of nitrogen from the soil, 25 pounds of phosphoric acid, and 50 pounds of potash, I do my best to strive for a bale per acre production to make this the minimum plant food added each year.

The kind and amount of commercial fertilizer used on cotton vary a great deal. This variation is caused largely by the way the land has been cropped, by erosion, and leaching. The soil type, the amount of rainfall, and other factors—such as what amount per acre you are striving for—all influence the kind of fertilizer to use.

*But I believe too little plant food is used in 90% of the cases. The healthy, fast-growing plant will do a lot to help control other problems.*

I always like a soil test each year and sometimes twice a year, so I will know just what my cotton needs. We have a county agent who really likes to inspect a good crop and he has never advised me wrong on what fertilizer to use.

### . . . About Peanuts

Folks in our area have long debated about the response of peanuts to fertilizer. I believe that you get your best response from *potash* where you are low in this element. Land that has run in peanuts for a number of years will certainly need this element added in some way.

I have found, also, that it is much better to apply this potash on some crop grown in rotation with the peanuts rather than directly to the peanuts. But I have had good response by applying direct, when it is evident that my peanuts were beginning to suffer from inadequate potash.

If you are growing peanuts on land used in a rotation with another legume, I doubt if you will need nitro-



gen applied to your crop. In all cases called to my mind, you will usually get a yearly growth response if a small amount of nitrogen in mixed fertilizer is applied at planting time—but by late summer, it will show very little difference from those planted without nitrogen.

Although phosphorus is an essential element, the peanut has a low phosphorus requirement, the specialists tell me. They say young plants may sometime show toxicity symptoms when too much phosphate—say 500 lbs. or more—is applied. When other crops grown in rotation with peanuts are properly fertilized, phosphorus fertilizers give little if any increase in yields.

I believe the important thing to remember in producing peanuts is to be sure that the soil is in proper balance. In many areas, manganese, boron, zinc, copper, and other trace elements are lacking. I have found that if you keep a proper soil balance and soil tilth, you will usually get a good all-round yield.

### ... About Wheat

I produce some wheat on my farm. I'm not a 15 or 30 acre man. But I have my own allotment of some 40

acres. If a farmer is not applying fertilizer to his wheat, he is most likely missing out on some good profit. I like to apply my fertilizer when I drill my wheat.

### ... About Other Important Practices

I have found if I get a profitable return, I must follow these practices:

1—Drainage. Poorly drained soil robs plant roots of air and stops the action of soil microbes.

2—Plants often run out of water before they run out of fertility. Keep the soil tilth so that when water falls it will stay there.

3—Best way to do this is to seed legumes.

4—Always be sure your fertilizer is the right kind to fill *your* needs.

5—Erosion can wash the fertilizer right off the field. Terraces and other practices should be used where needed.

6—Fertilize the right crop—the one you expect to be highest in price, the next highest, and so on.

These practices pay. Fertilizer pays. I know. I'm a farmer who uses it, based on what soil tests tell me. ■

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## SOIL TESTS PAY FARMER BLY

Marvin Bly and his son, Maurice, Dutch Hollow Road, Town of Ellery, are advocates of complete soil tests. Here's their story, as reported in *Chautauqua County, N. Y.*:

"We lost a lot of money by not having earlier soil tests on the farm we rent. It's alfalfa soil but the first year we tried it we lost our seeding. We used our old standard seeding fertilizer, 300 lbs. of 6-12-6.

"Soil tests told us we had almost a zero potash level. So, based on the soil tests and the recommendations that were made and our knowledge of the past history of the fields, we changed, and for the past two years have been using 200 lbs. of 0-20-20 at seeding time followed by a top dressing of 200 lbs. of 0-15-30. The result is the first and the best alfalfa we've ever grown. This year we really cut alfalfa."


Needless to say, Bly Farm will continue to make use of soil tests and we bet they will be enrolled in the "Ferti-Matic" program.

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# **FERTILIZER TAKES WINGS**

## **AERIAL FERTILIZATION OF MOUNTAIN**



**A demonstration that may lead to the reclamation and development of some half million acres of mountain pastures in western North Carolina.**

**Distributing 25  
tiller on some 10  
per acre . . . dosi  
ing from 30 to 60**

**“W**ELL, I never expected to see fertilizer spread up here.”

That comment was made by many farmers in the crowd of nearly 1,000 spectators who recently watched fertilizer take wings over hungry pasture-lands high in the Blue Ridge Mountains of western North Carolina.

The airplane is a well-established agricultural implement in many areas. It is used to apply pesticides and herbicides on row crops and range lands throughout this country.

Airplanes apply fertilizer used in the rice areas of Louisiana, Texas, and Arkansas.

In New Zealand, between 8 and 10 million acres of pastures are topdressed annually by plane, representing about 40% of the total fertilizer used in that nation.

Not until relatively high analysis fertilizers came along did airplane application appear to be a paying proposition on pastures in this country. We may be closer to it now than many think, especially in the mountain areas.

Two airplanes circling just above tree tops, spreading fertilizer on mountain pastures high in North Carolina, did more to stir the imagination of Watauga County farmers than anything in recent years. And well they should, because nearly 45,000 acres of similarly unlimed and unfertilized pastures await the roar of the airplane in Watauga County.

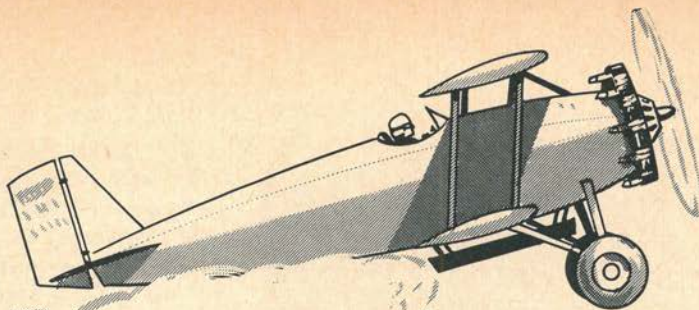
*There are over 500,000 such acres in 17 western*



**“Goodbye broomsedge,” said Mr. Robie gap at the top of his mountain pasture. Th the nearby pastures. Bluegrass and white to 500,000 acres of this and similar type pa**



# PASTURES



By SAM DOBSON  
Agronomy Extension Specialist  
North Carolina State College

tons of 0-30-30 fer-  
6 acres at 300 lbs.  
g grasslands rang-  
0 per cent slope.

**Showing a principle that could be applied not only to steep areas but also to flat lands that need fertilizing when it is too wet to enter the field.**

North Carolina counties. Some of this land is almost inaccessible, much of it is rough and all of it is steep!

*This land will grow grass: that is an established fact. Lime, phosphate, and potash bring white clover and bluegrass.* The Experiment Station has shown that a single application of 1 ton of lime per acre increases the yield about 1000 lbs. per acre per year for over 10 years. Reasonably small amounts of phosphate and potash applied every 2 or 3 years add another 1000 lbs. per acre every year.

Most of the more gentle slopes have been improved. But the vast acreage is steep and these farmers need a return from all acres—that's the problem!

Realizing this situation and knowing the airplane is being used in other areas, County Agent L. E. Tuckwiller organized an aerial topdressing demonstration with 9 farmers of the Beaverdam Creek community.

The county agricultural workers, the Western N. C. Development Council, The Tennessee Valley Authority, and the American Potash Institute co-operated in this demonstration.

The first problem was to find someone with airplanes willing to do the job. A team of crop dusters, Yadkin Valley Inc., from Winston Salem, N. C., became interested in this problem in the winter and spring of 1958. One member of the team, George Campbell, is the son of a Southwest Virginia farmer who was having problems topdressing his pastures.



As the plane spread fertilizer through the monoplane carrying 500 lbs. per trip topdressed over will follow lime and fertilizer if applied res in western North Carolina.





The nine farmers of the Beaverdam Creek Community and County Agent Tuckwiller discuss the airplane as a farm machine with the two pilots, Lloyd Lyons and Jack Parks (on near side of plane).



The mechanical loader speeds the job on the large plane. Here 1,000 lbs. of fertilizer are being loaded in less than one minute.

The Yadkin Valley men decided to see what their equipment would do on Farmer Campbell's pastures. They went on to topdress over 2,000 acres of neighboring pastures this spring and fall. Their experience indicates that *the materials can be applied by plane for \$1.25 per 100 lbs. and agreed to apply the materials for the demonstration at this price.* Their motto is, *"If a sheep or goat can graze it, we can fertilize it."*

The next problem was to select and prepare a suitable landing strip—one near the pastures to be topdressed. David Farthing had a small area of bottomland planted to corn. The corn was harvested, the corn rows leveled, and the strip packed with farm vehicles.

Next came the question of materials needed. A soil test was used to determine the amounts of lime and fertilizer to apply. The materials were then delivered to a shed near the landing strip.

The day of the demonstration came *and so did hundreds of farmers.* Many were skeptical at first, but they came and watched. They liked what they saw and the general comment was, *"I 'spect right many will take on to it."*

A total of 166 acres was topdressed during the two days. The pastures varied in size from 3 to 20 acres. 0-30-30 fertilizer was applied at the rate of 300 lbs. per acre. This was a per acre application cost of \$3.75 for 180 pounds of plant food—certainly cheaper than it can be done with hand labor.

In fact, it does not now appear that lime and fertilizer will ever be applied by hand in such mountainous areas. So it is by plane, or not at all. The planes fertilized one acre every 3 minutes while they were operating.

The pilots use trees, fence posts, rocks, and other natural landmarks to guide them in their flights back



and forth across the pastures. Everyone was well pleased at the apparent uniformity of application. There was very little drift of the materials because if there is enough wind to cause much drift, it is too dangerous to fly.

Some lime was also applied, and it spread beautifully.

Several problems must be solved before this practice goes very far in North Carolina. Most of the holdings are small. This means the neighborhood approach would seem to be necessary.

Suitable landing strips must be located and prepared. These strips must be near the areas to be top-dressed, both in distance and altitude. Quick loading is a must.

The size and shape of the pasture quite often cause more difficult and more expensive application. In other words, the more often the pilot has to cut off his applicator and turn, the more non-spreading flying time he has.

Planes that will carry more payload and remain highly maneuverable are needed. Then, too, the number of good flying days is limited, especially in the mountains.

Of course, no one knows how widespread this practice will become. It has certainly added new production possibilities to many acres of mountain pastures. We know a good job can be done with the airplane.

Other counties are becoming interested and other pilots, too. *Present costs and expected yield responses certainly indicate it is now practical.* Many small grain farmers who have trouble with wet land at topdressing time in February and March will be taking a good look at the airplane, too.

It appears that the airplane is destined to become a more important farm machine for the distribution of fertilizer. ■



People look on as the two planes begin loading to make the first trip across the Watauga County pastures.



The loader is a homemade bin attached to a hydraulically controlled pivot arm mounted on an old army truck chassis.



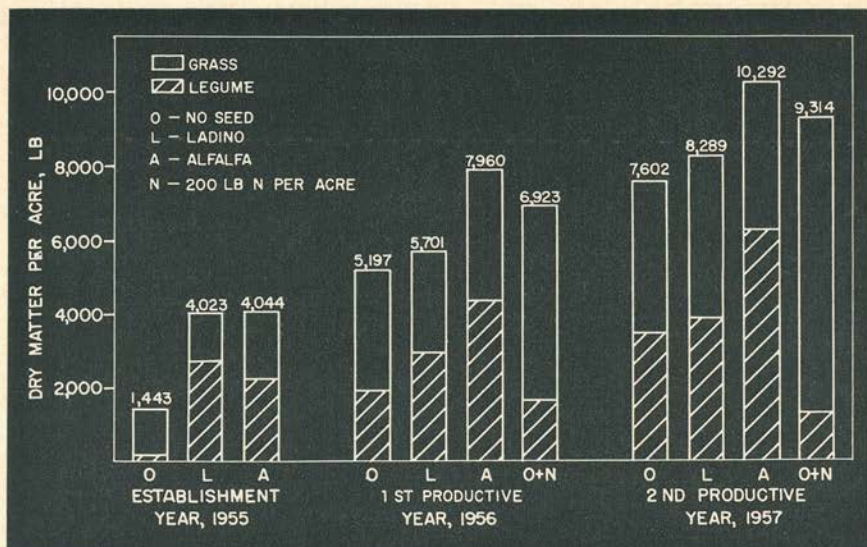


Figure 1. Here is the yield of a 7-year-old tall fescue that was moderately disked and given various seeding and fertilizer treatments in the spring of 1955 (Christian County, Kentucky, 1955, 1956, and 1957).

## IMPROVE GRASS PASTURES BY GROWING MORE LEGUMES

By T. H. Taylor, W. C. Templeton, Jr., and W. N. McMakin

Kentucky farmers think well of pastures and are devoting a large acreage to this crop.

Today, approximately two thirds or 8,401,000 acres of the open land in Kentucky is devoted to pasture production. These pastures produce everything from a few pounds of meat or milk per acre to 300 pounds or more of meat or 5,000 pounds of milk.

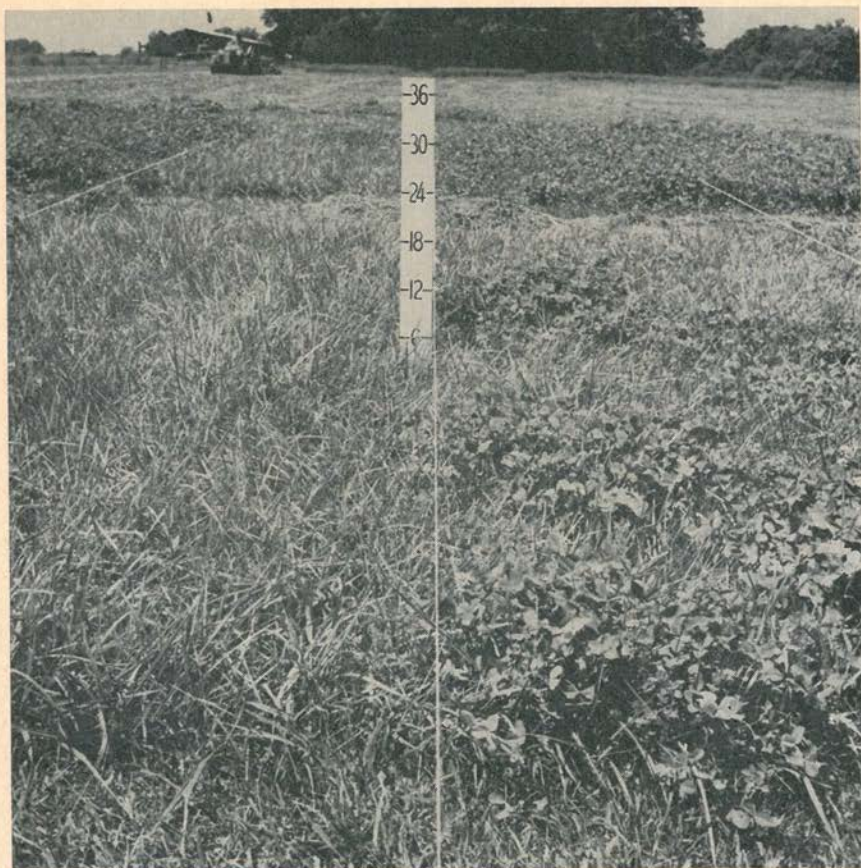
The job of improving poor pastures and maintaining good ones forever faces the livestock producer. Plant population in pastures continually

changes, a characteristic neither well understood nor fully appreciated.

Pasture vegetation changes with the season, with moisture or lack of it, with type of grazing and clipping management, with the kind and amount of fertilizer applied. To produce and utilize grasslands successfully, a farmer should have a working knowledge of pasture plants and how they are influenced by their environment.

One pasture problem many Kentucky farmers face year after year is





An old fescue sod disked moderately in August, 1955, but not seeded, pictured June, 1957, before 3rd harvest. Left, 200 pounds nitrogen per acre annually. Right, no nitrogen.

## Kentucky Agricultural Experiment Station

what to do with grass and grass-weed pastures. We realize cattle and sheep *do better when grazing grass-legume mixtures than when grazing pastures that are predominantly grass.*

Legumes apparently supply certain nutrient requirements of livestock more adequately than grasses. Also, properly noduleated legumes fix from the air enough nitrogen for their growth and some to spare for the associated grass.

Thus, growing legumes in a grass pasture improves the feeding quality

of the herbage and lessens the need for commercial nitrogen fertilizer.

### What Happens to Legumes?

Getting and keeping legumes in pastures is not easy. What causes legumes to disappear from pastures so quickly? Part of the answer is found in such factors as:

- (1) *Drought, diseases, and insect pests*—legumes are more susceptible to these hazards than grasses.
- (2) *Improper liming and fertilizing*—legumes have higher lime and



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different fertilizer requirements than grasses.

(3) *Improper grazing and clipping management*—if pastures are undergrazed and not clipped, the grass and weeds shade out the legumes. On the other hand, if pastures are overgrazed the legume plants may be so weakened that they perish.

What are some of the things farmers may do to improve the legume stands in predominantly grass pastures? The work reported in this article deals directly with this problem.

### Plan and Management of Experiments

In 1955, 1956, and 1957, several renovation experiments were set up in Christian County, Kentucky, on a 7-year-old tall fescue sod on soil tentatively classified as Pembroke silt loam.

Tests showed this soil to be slightly acid, very low in available phosphorus, and medium in available potash. Spring seedings were made in early March each year, and late-summer or early-fall seedings were

made in late August of 1955 and 1956. The main purpose of this work was to study the effects of different intensities of tillage, legume seedings, and nitrogen fertilization on the dry matter yield and grass-legume content of the herbage.

Prior to seeding, the experimental area received 2,500 pounds of lime and 600 pounds of 0-12-12 (borated) fertilizer per acre. These materials were broadcast and worked into the soil on blocks which were either disked moderately, disked heavily, or plowed. Lime and fertilizer were placed on the surface of other blocks that were not tilled. An additional 300 pounds per acre of the same fertilizer was banded directly under the seed during the seeding operation.

Plots of certified Atlantic alfalfa, certified Ladino white clover, and Kobe lespedeza were band-seeded across each block with a grain drill at the rates of 15, 3, and 20 pounds of seed per acre, respectively. In addition to the legume seedings, certified Kentucky 31 tall fescue was seeded on the plowed blocks at the rate of 5 pounds per acre.

Two plots on each tillage block were not seeded to legumes. One of these—the no-seed plot—received no nitrogen fertilizer. The other—the no-seed-plus-nitrogen plot—received 200 pounds of elemental nitrogen per acre per year in four 50-pound applications during the growing season. An annual maintenance application of 400 pounds per acre of an 0-20-20

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### To establish legumes in sods of cool-season grasses . . .

**1** Graze or clip the old sod closely before renovation.

**2** Apply needed lime, phosphorus, and potash.



(borated) fertilizer was spread on all plots in early spring. There were three replications.

The old sod was grazed closely (to a height of approximately 2 inches) prior to renovation. In the spring renovation experiments, the grass vegetation was cut in late April and again in mid-May above the legume seedlings. After the mid-May harvest, the legumes were permitted to become well established and each species of legume was cut as often as thought best for its well-being.

In the first and second productive years, the Ladino, no-seed, and no-seed-plus-nitrogen plots were harvested 5 times with a mowing machine which simulated rotational grazing, while the alfalfa and lespedeza plots were harvested as hay 4 times each year. Grass and legume contents were determined by making hand separations of samples from the 1st and 4th harvests and visually estimating the percentage of grass and legumes in the other harvests.

### Experimental Results

Dry matter yields of moderately disked plots during the establishment, 1st productive, and 2nd productive years of the 1955 spring renovated experiment, are shown in Figure 1.

Tillage effects are shown in Figure 2 by a 3-year average (1955-57) of this experiment and a 2-year average (1956-57) of the 1955 late-summer



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seeding.

Data from the 1955, 1956, and 1957 spring-renovation experiments illustrate the effects of different seasons on total production and proportions of grass and legumes, shown in Figure 3.

ESTABLISHMENT YEAR (1955). Precipitation from March through June, 1955, was 3.48 inches above normal. With abundant moisture, good to excellent stands of legumes were obtained regardless of tillage treatment.

A drought began in July and continued until the latter part of September, with a deficit from normal of 4.57 inches of precipitation for this period. Dry matter production was increased from 1,443 pounds per acre (13% legume) to 4,023 pounds (68% legume) by seeding Ladino clover and to 4,044 pounds (56% legume) by seeding alfalfa (Figure 1).

No visible legumes were present in the early spring of 1955 when

- 
- 3** Disk sufficiently to disturb 40% to 60% of the existing vegetation.
  - 4** Seed adapted legumes at the proper time and at or near recommended rates for pure stand seedings.
  - 5** Keep the grass short by judicious grazing or clipping during the early establishment of the legume seedlings. Thereafter, direct management toward the well-being of the legume in the mixture.
  - 6** Control harmful grass-legume insects as needed.
-



renovation was started. However, this sod was originally a fescue-Ladino mixture and the legumes in the no-seed plots undoubtedly originated from Ladino and common white clover seed in the surface soil of the old sod.

**FIRST PRODUCTIVE YEAR (1956).** From March through October, 1956, precipitation was 8.41 inches below normal. Long-time average or normal precipitation for this period is 30.41 inches. Dry matter production was 5,197 pounds per acre (38% legume) for *no-seed* plots; 5,701 pounds (52% legume) for *Ladino*; 7,960 pounds (55% legume) for *alfalfa*; and 6,923 pounds (24% legume) for *no-seed plus 200 pounds of elemental nitrogen* (Figure 1).

The volunteer clover in the no-seed plots increased from 13% in 1955 to 38% in 1956. This increase, coupled with adequate mineral fertilization, accounts in part for the high yield of this treatment. On the other hand, clover content on the no-seed-plus nitrogen plots was only 24%.

**SECOND PRODUCTIVE YEAR (1957).** During the growing season of 1957 (March through October), precipitation was 7.51 inches above normal with much of this excess occurring during the flush grass-legume growth

in April and May. Abundant moisture was present again in July. Excellent forage yields were obtained and the yield pattern among the treatments was approximately the same as in 1956 (Figure 1). No-seed plots increased in clover content from 38% in 1956 to 46% in 1957, while clover in the no-seed-plus-nitrogen plots decreased from 24% to 14% during the same period.

**EFFECTS OF TILLAGE.** Some of the effects of different tillage intensities prior to seeding legumes in an old fescue sod renovated in spring and late summer are shown in Figure 2. In the spring-renovated experiment, three-year-average yields of all legumes combined were: *no tillage*, 5,225 pounds per acre (50% legume); *disked moderately*, 5,995 pounds (52% legume); and *plowed*, 5,063 pounds (44% legume). These data indicate no difference in production between the no-tilled blocks and the plowed blocks. However, the disked-moderately blocks were somewhat higher yielding.

In the late-summer or fall-renovated experiment, the 2-year (1956-57) average yields were: *no tillage*, 4,470 pounds per acre (31% legume); *disked moderately*, 6,088 pounds (42% legume); and *plowed*, 5,816

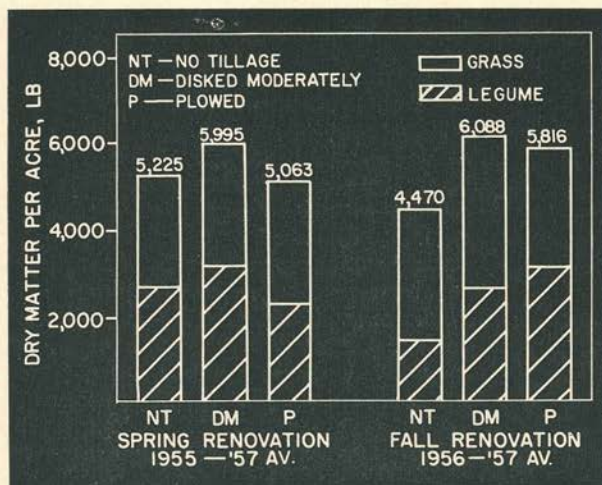


Figure 2. Here is the effect of different tillage intensities on the production of an old fescue sod when renovated in the spring and in the late summer of 1955. The alfalfa, Ladino, lespedeza, and no-seed plots are combined into one figure at each tillage level. (Christian County, Kentucky, 1955, 1956, and 1957.)



pounds (53% legume). These data show that for successfully establishing legumes in the old sod in late summer, when moisture was limited, *more tillage was necessary than in early spring.*

In both the spring and fall experiments, production of the blocks disked moderately was equal or superior to that of the plowed blocks (Figure 2).

**SEASONAL EFFECTS.** Seasonal variations in dry matter production and legume content during establishment and first productive years for three spring-renovated experiments are shown in Figure 3. Data for all legumes and tillages are combined into one yield figure. Seasonal dry matter yields for the establishment year were 3,387 pounds per acre (54% legume) in 1955, 1,993 pounds (46% legume) in 1956, and 5,921 pounds (40% legume) in 1957. Yields during the first productive year were 4,659 pounds per acre (44% legume) in 1956 and 6,765 pounds (43% legume) in 1957. These wide variations in production from season to season seem due largely to the amount and distribution of precipitation during the growing season.

### Discussion

Only the initial phases of this research have been completed and firm opinions and conclusions are not warranted at this time. However, certain obvious trends deserve discussion.

Three *spring* and two *late-summer* seedings were made.

Excellent stands of legumes were obtained from two of the spring seedings while the third was poor to fair.

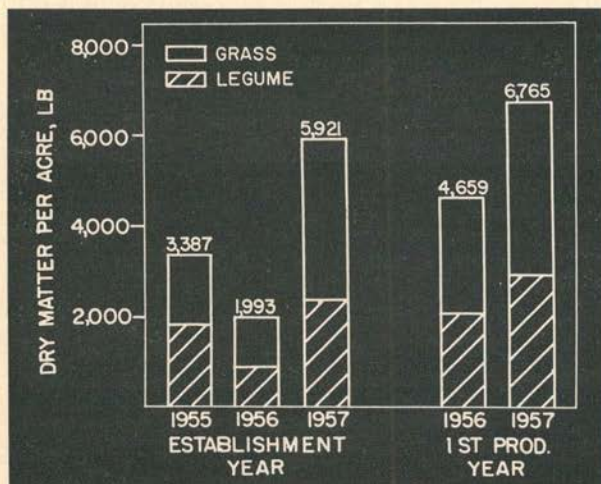
Of the two late-summer seedings, the one made in 1955 was very successful while the 1956 planting was a complete failure.

After lime, phosphorus, and potassium needs are met, *weather appears to be the most dominant factor* in establishing legumes in an old sod. Success depends greatly on favorable moisture conditions at the proper time.

The next most important factor seems to be *tillage of the old sod prior to seeding.* Under the conditions of these experiments, dry matter production of the blocks disked moderately has been equal or superior to the plowed blocks.

One may wonder why this is true. Perhaps it is because plowing brought

Figure 3. Seasonal dry matter production during the establishment and first productive years of old sod renovated in spring. All legumes and tillages are combined into one yield figure. (Christian County, Kentucky, 1955, 1956, and 1957.)





to the surface sub-soil that was low in organic matter and, therefore, more droughty. Disking, on the other hand, left the organic matter (shoots and shallow root material which had accumulated over a period of 7, 8, or 9 years) on or near the soil surface.

Because of this, or other reasons, the environment created by disking was apparently as favorable for germination and establishment of the legume seedlings as that existing on the plowed areas. Also, established fescue plants on the disked blocks contributed to the initial production more than the grass seedlings on the plowed blocks.

*Grazing or cutting management*

during establishment of legumes is very important, especially when no tillage or disking is done prior to seeding.

Data obtained, but not presented in this article, indicate that the grass should be grazed or clipped relatively short during emergence and early establishment of the legume seedlings. *Later management should favor the seeded legume rather than the grass.* Data and observations obtained from two experiments indicate that *successful management depends greatly on controlled grazing or on clipping.*

*The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published with approval of the Director.* ■

## REVIEWS

January-February 1959

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Orchard Fertilization Ground and Foliage	X-8-51	_____
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The Relation of Potassium to Fruit Size in Oranges	J-4-56	_____
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Potash in Agriculture	3-1-56	_____
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How So Few Can Produce So Much	GG-11-58	_____

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## Does Your Soil Sizzle?

Is your soil sizzling? Did you know that the temperature of a dark-colored, unprotected soil can reach 140 degrees Fahrenheit or higher? Darker soils absorb the sun's radiation, and a light-colored soil will reflect radiation. Light soils will absorb about 30 per cent of the sun's radiation; dark soils can absorb 80 percent or more.

The high temperatures are found only in the top inch of the soil, but they cause much damage to soil, bacteria, organic matter, and vegetation. Moisture is stolen from the soil by evaporation. Lack of moisture reduces plant growth. Seedlings may not germinate or may grow poorly. Research shows that the best seed growth occurs when the soil temperature is 65 to 80 degrees Fahrenheit. Temperature over 100 seriously impedes seed growth, and can stop germination.

Many of the useful soil bacteria are killed by high temperatures, and therefore organic matter breakdown is reduced. The ideal soil temperature for soil bacteria ranges from 75 to 95 degrees. Temperatures above 95 are harmful.

To keep your soil cool, the logical step is to shade it. Shade can be provided by mulch or vegetation. A good cover of stubble on a field can keep the soil temperature up to 30 degrees cooler than the same field without stubble. A good cover of grass on well-managed rangeland can reduce soil temperature by as much as 28 degrees. A poor stand of grass on overgrazed rangeland will not provide much shade.

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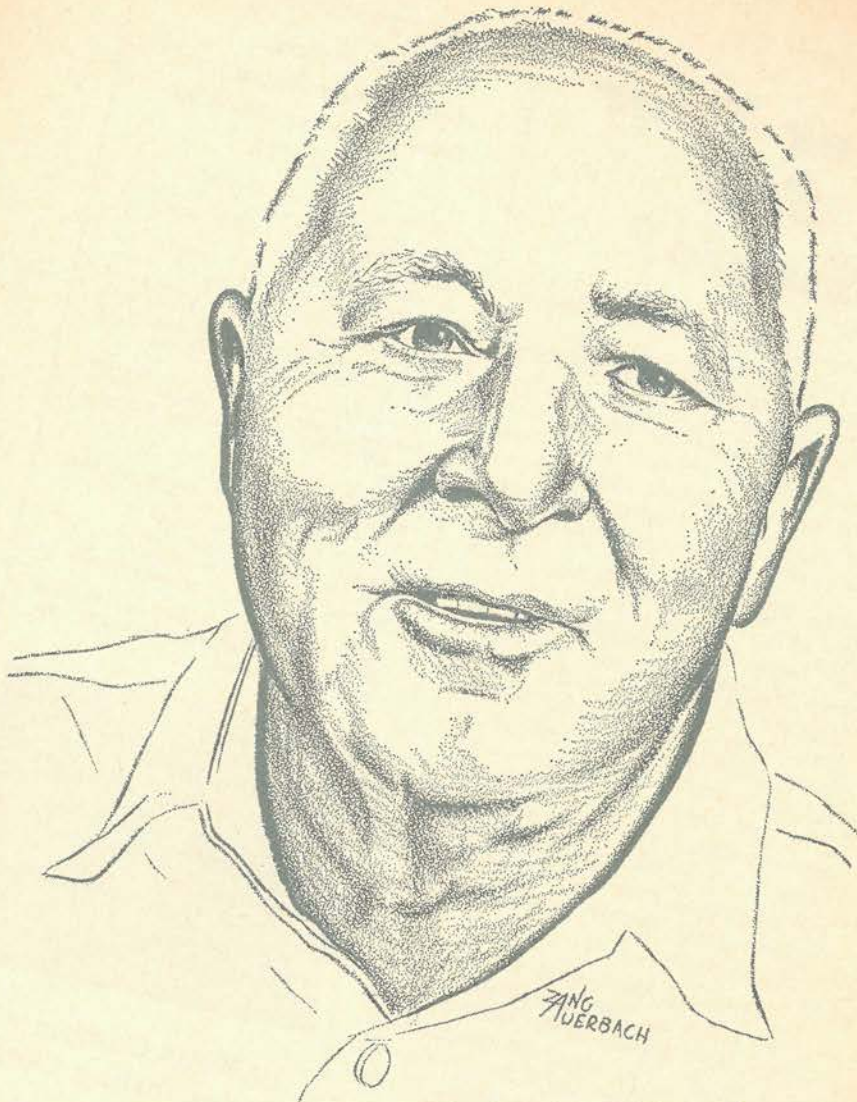
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HUGH HAMMOND BENNETT



# HISTORY IS ALREADY SHINING ON HIM

## SOME IMPRESSIONS OF HUGH H. BENNETT FATHER OF SOIL CONSERVATION

By Santford Martin  
Editor

A SPECIALIST in agricultural advertising recently said one of the biggest problems facing agriculture today is the job of selling itself to the public.

By the public, I presume, he meant those 87% or more citizens who don't farm but who pay most of the taxes that support the U. S. Department of Agriculture.

Pondering this problem, my thoughts turned instinctively to a 77-year-old man now living in retirement by his fireside across the Potomac from Washington. A man whose vast experiences, knowledge, and fearless love of the earth sold an agricultural idea to the nation as successfully as any product has ever been sold. A man who has been called the "father of soil conservation."

Few men in American history have combined science with showmanship as skillfully as Dr. Hugh H. Bennett did to get an urgent job underway quickly and efficiently.

At least, *he* thought it was urgent—and so did the late Franklin D. Roosevelt under whose administration the U. S. Soil Conservation Service was created.

But that's getting ahead of the story.

In fact, the story of Big Hugh Bennett has been told many times, in many places, by many people far more adequately than I could tell it—by Wellington Brink in the biography, *Big Hugh*, published by Macmillan; by Robert D. McMillen in the *Farm Journal*; by the *Progressive Farmer* magazine; by Louis Bromfield; by countless local reporters on county seat newspapers who knew and liked the man for what he was unafraid to do.

My reason for looking into the Bennett legend was to secure some impressions of the techniques and personality that it took to sell soil conservation to America in the face of endless rebuffs that would have felled a lesser man. And from those impressions, perhaps, to secure at least a suggestion of how agriculture might better sell itself to the public.

In the story of Hugh Bennett can be found nearly all the elements that have made American agriculture the bountiful provider of mankind—elements of discovery, of error, of the best and worst practices, of pet theories, of mass applications, of big men sharing their findings, of little men



hovering jealously over their plots, of the people demanding adequate food supplies, of devoted public servants working around the clock to get them that food—even unto surpluses—of selfish little bureaucrats rushing back and forth in tight flannel suits toting brief cases bulging with ideas on how to meet the Farm Problem in a politically successful way, of a few dedicated scientists urging the nation to put more science and less politics into solving—and perhaps dissolving—the Farm Problem.

From the banks of the Pee Dee River in Piedmont North Carolina, Hugh Bennett came to Washington, D. C. in 1903 to join the old Bureau of Soils. The big, gangling chemistry graduate of the University of North Carolina got the assignment he wanted—classifying and mapping soil by individual type units and observing their productivity, in Tennessee, Alabama, the Carolinas, and Virginia, outside the laboratory, in the field, on the soil, under the sky.

From then until 1951, his career led uphill, up gullies most of the way, until he caused farm and town people alike to identify themselves with soil conservation.

And how he did it caused the publishers of *Farm Journal* to call him "one of the few immortals of agricultural history."

Before you can understand the Bennett techniques, you must know something of the Bennett background—what he went through to sell an idea that had its first conscious birth on some hard clay land in Louisa County, Virginia, in the spring of 1905.

To describe that birth in Dr. Bennett's words:

"Bill McLendon of Bishopville, S. C., and I were stirring through the woods down there in middle Virginia when we noticed two pieces of land side by side, but sharply different in their soil quality. The slope of both areas was the same. The underlying rock the same. There was indisput-

able evidence the two pieces had been identical in soil makeup.

"But the soil of one piece was mellow, loamy, and moist enough even in dry weather to dig into with our bare hands. We noticed this area was wooded, well covered with forest litter, and had never been cultivated.

"The other area, right beside it, was clay, hard and almost like rock in dry weather. It had been cropped a long time.

"There had been no erosion in the wooded area—beyond a trace of natural erosion. But the clay on the unprotected, cultivated field was like the subsoil of the wooded area.

"We figured both areas had been the same originally and that the clay of the cultivated area could have reached the surface *only through the process of rainwash*—that is, the gradual removal, with every heavy rain, of a thin sheet of topsoil. It was just so much muddy water running off the land after rains. And, by contrast, we noted the almost perfect protection nature provided against erosion with her dense covers of forest."

The young scientists saw that sheet erosion had gradually stripped off the original 8 or 9 inches of topsoil from the bare, heavily cropped field. And at that point in his life, Hugh Bennett developed this concept:

"The red, yellow, and black colors of floodwaters running away to the sea are no reflection from the sky; the color of such floodwaters is produced by the color of the soil material swept out of fields and carried off in suspension. This material comes from the surface of the ground, the best part of our fields, and thus impoverishes the land."

That doesn't seem like such a startling theory—today. But for a 24-year-old chemist, just two years out of college, it was enough to cause USDA officials of 1905 to squelch the idea sharply in the bulletin they issued on the survey Bennett and his associates had made.



And why not? The Chief of the Bureau of Soils wrote 4 years later, in 1909, (Bulletin 55): "The soil is the one indestructible, immutable asset that the Nation possesses. It is the one resource that cannot be exhausted."

Looking at that statement later, Bennett said, "I didn't know so much costly misinformation could be put into one brief sentence."

Two years after Bulletin 55 was published, Bennett and his team made their second important discovery in Fairfield County, S. C., in 1911. Here he found 136,000 acres of formerly good, cultivated land ruined for any further cultivation by either gully erosion or smothering deposits of erosion debris washed off the uplands. In addition, he found another large area seriously damaged by sheet erosion.

This time the survey report was devoted largely to the erosion findings—the first such survey ever made of a large area outlining the devastating effects of erosion. And the USDA printed it. Bennett and his associates thought it would arouse some interest in the problem. Nothing happened.

He said, "That publication didn't even ripple the surface of our national complacency toward the security of our productive land."

They found similar damaging effects in Stewart County, Georgia, and in Lauderdale County, Mississippi, and reported them. The reports were printed. Some people laughed. But most of the people paid no attention. When questioned, Bennett would always say, "Let's go out and take a look at what I'm talking about."

But very few people had the time or interest to go out and take a look—in the beginning.

He concluded, "I guess they thought they were right. They figured we've always got more land to move to—and it was nothing we could do anything about, anyway. They thought it was a process of nature over which man has no control."

It *was* a process of nature. But man could control it, Bennett argued, and would eventually have to control it *to survive*. So, beginning around 1918, he became more outspoken about erosion—speaking to scientific groups that would listen, to farm gatherings, writing for newspapers, farm journals, and occasionally developing special features for monthly magazines.

In fact, to many agricultural scientists who measure a man's ability by the number of articles he can get published, Hugh Bennett should be something of an idol.

According to his biographer, "It is probable that Bennett's signed production adds up to well over 1,000 items of importance."

Among these are five books, over 400 technical, semi-popular, and popular papers, and hundreds of soil survey reports, magazine articles, and miscellaneous materials not officially totaled by the USDA. Included is a volume many people regard as a classic in its field: *Soil Conservation*, a 1,000-page book on the subject to which Hugh Bennett has given his life.

But the spark that started the first important flame for soil conservation was his now-famous "menace" bulletin, issued in April, 1928, around his 47th birthday. The title: *Soil Erosion, A National Menace*.

For the first time, someone responded with more than an indulgent smile or academic smirk—or indifference. Congress invited Bennett to appear before its Appropriations Committee to suggest what the nation might do about its soil erosion problem.

As he walked over to meet that committee, his thoughts raced back to Anson County, N. C., to the Piedmont hills on his papa's farm and the first question he ever asked about erosion. He was 10 years old at the time. He was helping his father lay off terrace lines, in the spring of 1891, for plows to follow in constructing the terraces.



At one point, he looked up and asked, "Papa, why are we going to all this trouble?"

"To keep the land from washing away," his father replied simply.

The seed was planted, consciously or unconsciously. And when Hugh Bennett entered that committee room in 1928, he was determined to convince those Congressmen of one thing: the urgent need to do something to keep the nation's productive land from washing away.

He did convince them. They appropriated \$160,000 to investigate the erosion problems of the nation—to measure erosion rates, to calibrate the different kinds of land according to their life expectancy and capability to produce, and to develop new and better methods for controlling erosion.

The legislation was adopted in both houses of Congress by unanimous votes. Bennett was assigned to boss the investigations. It was a small sum compared to the \$125 million the Soil Conservation Service was later offered. But it was a start.

In 1933, Bennett heard rumors of a program to build terraces to stop erosion. He did not hesitate to go to the Undersecretary of Agriculture, Rex Tugwell, and tell him what he thought of such a scheme.

"I told Undersecretary Tugwell such a plan was too simple," he explained. "I told him many terraces might be put in the wrong place. In fact, when we started our program of modern soil conservation, we had to tear down about 90 per cent of all the terracing that had been put on the land, mostly by farmers who had never been shown how to build terraces properly.

"I told him most terraces had been built or used on land too steep—or on soil not suited to terracing. I told him that although good terraces might be built, they should be supplemented with strip cropping, contour plowing, grassed waterways, and crop rotations.

In other words, I told him what I thought."

That was not the first time Hugh Bennett told an Undersecretary or a Secretary of Agriculture what he thought, nor the last. Always up gullies he seemed to plod—to have to plod—not only up gullies of clay but also gullies of prejudice, reaction, and petty jealousy.

One morning he was called into Secretary Henry Wallace's office where a group of "colleagues" had gathered to prime the Secretary on an amendment that was already in the hands of a Senator to be offered to Congress when the Secretary gave the green light. The amendment was designed to relieve the Soil Conservation Service of all its duties except research and surveys and to give Hugh Bennett more time "to rest, write, and think."

Secretary Wallace asked Bennett what he thought of that. Bennett replied that he didn't like any part of the proposal. And then he launched into a brief but moving account of how it had taken three decades to sell a soil conservation program farmers would accept and use. He concluded by saying he was sorely disappointed at the attempt to disrupt a successfully going program just because the group claimed they could do the job better, faster, and at less cost without producing any evidence of being able to do it at all.

Early the next morning Secretary Wallace called Bennett back to his office. The "colleagues" were not present. They had departed for home posts. Wallace told Bennett that he had not slept much the previous night, thinking about what had happened. He then assured Bennett that the Soil Conservation Service would continue as it was—that Senator (Blank) would not present the amendment to turn the Service over to any other agency.

After Bennett had expressed his adverse views on the proposed terracing program in 1933, Tugwell called Harold Ickes, the Secretary of Interior,



and suggested the possibility of starting a comprehensive soil erosion program in the Interior Department under the new National Industrial Recovery Administration.

As director of the new program, Bennett worked fast. He set up 40 demonstration erosion-control projects, from 25,000 to 200,000 acres each, mostly on private lands in 31 states. His labor came largely from CCC—Civilian Conservation Corps. He also used relief funds to hire people who needed employment to feed their families in that day of deep depression.

By law, Bennett had to hire a certain percentage of people on relief. Harry Hopkins, well known trouble shooter for Roosevelt, clashed with Bennett over the number of people he was taking off of relief. Hopkins thought it should be more. Bennett argued that he had to have competent people to operate the projects and he was using what he could.

He had been operating the soil erosion work in Interior about 18 months when his office phone rang one afternoon. As he answered it, the operator said, "Dr. Bennett, this is the White House. The President would like to see you right away. Can you come at once?"

When Bennett walked into the President's office, Roosevelt said, "Bennett, I got you over here to congratulate you and your technicians in the Soil Erosion Service on the good job you folks are doing. You want to know how I found out about it?"

"Yes, sir," Bennett replied with much interest.

"They're after you, Bennett. And when they are after somebody, he's usually doing a bang-up job. Bennett, doesn't this erosion business have an agricultural twist to it?"

"Very much so," Bennett replied.

"Do you have any antipathy toward the Agriculture Department?" Roosevelt asked.

"No sir," Bennett said. "I've spent most of my life over there."

"Well, Bennett, I don't know what's going to come out of this," FDR explained.

"Mr. President, if the outcome means we are to move into another department, I'd appreciate it if you'd let Mr. Ickes know that we appreciate how good he has been to us," Bennett asked FDR.

"Oh, I'll attend to that, Bennett," the President assured him.

And so Big Hugh was on his way back to the USDA, with the support of one of the most singularly powerful men ever to sit in the White House.

I could not refrain from asking, "Who were 'they' that Roosevelt was talking about?"

"They' were a bunch of bureaucratic-minded boys of a highly acquisitive nature," Bennett laughed, as he loosened the belt in his denim pants a notch.

It's all a matter of public record now. For many years—seven consecutive years, in fact—it was a traditional event for certain farm organization representatives to bear down on the House's Appropriations Committee urging that all funds requested for soil conservation be turned over to their favorite agencies.

But that's getting ahead of the story again.

On April 27, 1935, the President signed Public Law 46, the first soil conservation act in the history of this or any other nation, creating the Soil Conservation Service as a permanent agency of the Department of Agriculture.

When Bennett and his associates launched the new service, only one of the 48 state agricultural colleges sent specialists to Washington to help plan the program. That was the University of Wisconsin—Noble Clark and his associates—who have cooperated through the years. Some of the colleges did not seem interested at the time.



In fact, one of the most intriguing facets in the whole soil conservation story was the evolution from total indifference to total interest in the attitude of many agricultural specialists. Why they were indifferent in the beginning is anyone's guess. Why they became exceedingly interested later on is probably found somewhere in the answer Bennett gave to the following question:

"What did you do," I asked, "to sell the idea of soil conservation after so many years of rebuffs?"

"We decided on four steps," he replied, "*science, farmer participation, publicity, and Congressional relations.*"

And what Hugh Bennett meant by those four steps are somewhat classical to report.

Of step 1, *science*, he explained.

"By science, I mean we tried to imitate nature as much as we could. We abided by the following basic physical facts, which were in force then, are now, and always will be: (1) land varies greatly from place to place, due to differences in soil, slope, climate, and vegetative adaptability; (2) land must be treated according to its natural capability and its condition as the result of the way man has used it; (3) slope, soil, and climate largely determine what is suitable protection in all situations.

"We differentiated between land and soil. We worked out eight classifications of land that the farmer could understand and use for his guide.

"Our technicians were instructed to take their experimental findings out to the farm and apply them on a large scale, under actual soil, climate, and land conditions the farmer faces. It was the first time a whole farm had been walked over and scientifically planned for conservation, field by field.

"You know, we scientists can back off in some little greenhouse or 12-foot plot and run test after test, in replica, delighting ourselves and our colleagues with the results we are getting, and writing papers on the results

to read at scientific meetings. But if old Zeke Thompson down on the Pee Dee can't use it, it isn't worth much, in my judgment.

"I have always been a little skeptical of the kind of science conducted solely for the edification of fellow scientists. That goes on, you know, and some of it may very well fit in this science revolution we're now entering.

"We tried to staff our work with able scientists and technicians. Einstein's son worked with us. He was good. C. W. Thornthwaite, now with Johns Hopkins, was our climatologist—probably the best in the world. The team was always energetic and cooperative.

"Our boys started making discoveries, acquiring new land facts, and developing methods that had long needed discovering and developing but never had been. We developed strip cropping. We put the 100-year-old practice of field terracing under the scrutiny of research. We developed grassed waterways, contour rotations, and many more practices and principles to protect the land.

"We encouraged range and pasture seeding with new and better grasses, the use of modern forestry practices in woodland management, and widespread development of farm ponds. When we started, there were only a handful of farm ponds in this country. Today, I understand, nearly 400,000 ponds serve our farms. We encouraged tree planting, where necessary, drainage of wet cultivated lands, irrigation land preparation, and improved methods of applying water.

"And in all these practices, we emphasized the right use of plenty of fertilizer, good hybrid seed, improved insecticides and pesticides, and many other fine recommendations our fellow scientists were making.

"But above all, as I said, we tried to imitate nature. We should always listen to nature and work with her. The old lady is very wise and very cooperative, having learned ages ago how to keep land perpetually produc-



tive by abiding by her own basic laws of creation.

"You can't farm a flat Indiana field like you would a rolling Georgia slope, nor a Vermont mountainside like a Texas river bottom. It was that simple and that complex."

Many of the nation's farmers agreed with Bennett, apparently.

By the year he was ready to retire, he could report to Secretary of Agriculture Brannan that combined treatment with all needed conservation measures had been applied to 140 million acres in the United States. He could report that basic conservation farm and ranch plans were then being used on about 247 million acres, including the estimated acreage of farmers who had taken up soil conservation practices on their own. He could report that detailed soil conservation surveys had been made, and land-capability maps completed, acre by acre, on about 377 million acres.

In brief, he was able to report, "More than one-fifth of the basic conservation job needed for full protection of our farm and ranch land has been completed."

Anyone who would say a mere scientist could influence the destiny of that many acres in that short a time doesn't know the American farmer—or Hugh Bennett. It took one-third scientist (or opportunist, depending on your point of view), one-third statesman (or politician, depending on your point of view), and one-third salesman (or showman, depending on your point of view).

Of step 2, *farmer participation*, he said:

"We soon learned that we couldn't do the whole conservation job all by ourselves. And we needed to go ahead faster with the job. Rumors were running that we weren't getting enough done.

"That's where the need for the Soil Conservation District sprang up. We had to have the farmer's participation. And the district idea was a plan to get

him interested in practicing conservation by giving him a big share of the responsibility. The farmers organized their districts by referenda and directed them under enabling legislation by the various states. Soil Conservation Districts were organized as units of state government under these acts.

"We realized farmers weren't going to do their best to improve their land and water resources unless they had a major part and say in these efforts. And the district idea was the most democratic approach we could think of. Everything we did was voluntary from beginning to end. We never undertook to install conservation measures on a farm until the farmer agreed to everything we proposed to do.

"We would walk over a farm with the farmer, field by field, and suggest a farm plan for the different kinds of land over his whole farm. Our recommendations were applied by the farmer himself, with technical guidance from our staff. Farmers liked this approach. They cooperated by the hundreds."

Bennett is right. Soil conservation demonstrations became famous. Tens of thousands flocked to observe the regular SCS demonstrations. And hundreds of thousands came to watch District sponsored "face-liftings." The District system soon became known around the world as one of the most democratic and practical ways to get farmers to safeguard their land and improve their methods while using their land. The idea has spread into 15 foreign countries.

The story of Soil Conservation Districts has been a story of higher per acre yields, increased income, improved social and economic conditions. Special studies of farmers following soil conservation treatment have shown that soil conservation practices increased their production 20, 30, 60, and sometimes 100 per cent.

A good example is Claude Milner, an Iowa farmer whose farm was the first to receive the famous district



"face-lifting." After applying soil conservation practices, his production from permanent pasture more than doubled, his corn yield jumped from 30 bushels per acre to 60 bushels. And the total output of his farm increased 100 per cent.

No wonder there were 2,329 Soil Conservation Districts in operation the year Hugh Bennett retired, composed of 4,886,487 farms on 1,305,110,007 acres. That was a long distance from Bulletin 55.

It is interesting—historically as well as scientifically—to observe how the nation's crop yields per acre started rising sharply during the 15-year period between 1935 and 1950. It is not altogether coincidental that the soil conservation movement had its birth and rise during the same period. Soil conservation practices have contributed much to the historical increases in our per acre yields. No real student of the past two decades will question that fact.

Of step 3, *publicity*, Bennett explained:

"By publicity, I mean we employed capable writers, trained journalists who knew what to write and where to get articles published. They were not agronomists or agricultural engineers trying to be reporters or advertising men. They were journalists who knew good pictures, good news angles, good feature possibilities when they saw them. And I let them go at it, in their way, which happened to be the newspaper and radio way.

"The country papers picked up our boys' material by the volume—and used it—and it got back to Congressmen because they read their country papers. We had many evidences of that. Our clippings piled up. Requests for more information poured in. Our relations with the press were always, to my knowledge, on a positive and useful plane. We considered the press and radio a very important part of our job."

Bennett is right, according to rec-

ords in the USDA and elsewhere. Few government programs have been as successfully promoted in the press of this nation—and in other parts of the world—as SCS. Thousands of favorable editorials and articles have been written by country and city editors alike, extolling the work of soil conservation. Scores of county newspapers have issued special editions on soil conservation.

A good example was the *Ray County Herald* of Richmond, Missouri. One week it came out with a special issue, all dressed up, called "The Greener Pastures Edition." Nearly every business house in town plugged some phase of soil conservation in their ad. Contour plowing. Strip cropping. Grassed waterways. Proper fertilization. In terms the average farmer and banker could understand.

Banks have run whole series of ads on conservation. And in most instances, the material for such editions and many of the ads came from SCS publicity men. Never high-hat. Always down-to-earth. Pitched for the layman. Because Bennett had no patience with scientific gobbledygook and pomposity. He was out to sell an idea. When you get chambers of commerce and branch-head farmers working together on the same project, you're selling something—if nothing but better understanding. But Bennett was selling more than understanding—he was selling preservation. And everyone can work up some pretty common interest in that, when they think about it.

Of step 4, *Congressional relations*, he said:

"We kept Congressmen informed of conservation work in their home districts—what we planned to do in their districts—so they could use that information when they went home to visit.

"We made it a point to know most of the rural Congressmen personally—and they knew us. Cooley, Cannon, Farmer Bob Doughton, Bob



Pogue, Sam Rayburn. And I always told farm folks back in the districts to contact their Congressman.

"One day I got a call from a Congressman who said he was in trouble. I asked him what was wrong. He said he needed someone to make a speech for him, a fellow who could get beads of sweat up in a talk to farmers. I told him I had such a man.

"We always tried to present our needs to Congressional Committees in an interesting and respectful way when they called us up. Some fellows appearing before those committees would get smart. Talk back to Congressmen. That doesn't pay."

Bennett's appearances before Congressional Committees became legendary.

"When I appeared before a committee," he continued, "I never talked about correlations or replicates. But I did spread out a thick bath towel one day on a table before a committee, tipped the table back a bit, and poured a half pitcher of water on that towel. The towel absorbed most of the water, cutting its flow from the table to the rug.

"I then lifted the towel and poured the rest of the pitcher on the smooth table top, watching it wash over the edge onto the rug. I didn't say anything right away—just stood there looking at the mess on the floor. Then I looked up at the committee and explained the towel represented well-covered, well-managed land that could absorb heavy, washing rains. And that the smooth table top represented bare, eroded land, with poor cover and management on it. They seemed to understand, because we got our appropriation.

"We liked to use eye-catching illustrations. We had plenty of them, and we could back them up with scientific facts. Don't ever use eye-catchers without the land facts to support what you're trying to sell."

It wasn't Bennett's statistics that caught the fancy of Congress. It was

his showmanship, his salesmanship. He was never afraid to use simple devices, simple illustrations—like a jar of honey produced from *Lespedeza bicolor*. Like a 100-year-old fence post made of shipmast locust which is sturdy wood that will grow in gullies or out-of-the-way places. Like a Mack Gowder plow without a mouldboard, the kind that doesn't turn under crop residues but leaves them on the surface as mulch.

He usually came lugging these devices into the committee room himself, with his hair ruffled, tie twisted, vest half buttoned, and trouser cuffs dragging. But Congress liked it. And so did the people.

According to persons familiar with him and his work he was never stiff, formal, scientifically aloof. He had sufficient confidence not to be. He never seemed concerned about what his colleagues thought of him. He never quivered over making an occasional mistake in front of them. He had a mission—to sell soil conservation—and a talent for never taking *himself* too seriously in that job. He was cheered. He was laughed at. He was cursed. He was even betrayed. But he proceeded forward, up the gullies, at all times.

I found him to be both a modest man and an immodest man. Both an objective man and an unobjective man. His immodesty is one of the most honest traits in him. And his lack of pure objectivity, at times, was a trait farmers could understand. He is, very obviously, a farmer's scientist—not necessarily a scientist's scientist. It is easy to see why farmers have always liked him immediately, instinctively.

There is nothing dapper about him. He has never had to assure farm audiences that he remembers what the south end of a northbound mule looks like between corn rows on a hot June day. It is obvious that he does.

Once in Brazil, as Bennett's old hat flopped in the breeze, the Secretary of Agriculture there said of him, "This



fellow looks like a 'Cobocla'—which means a Brazilian rustic. In other words, a real dirt farmer. Few descriptions have pleased Bennett more.

He has never deserted his heritage—or been ashamed of it. He still talks with the Piedmont North Carolina accent he brought to Washington over a half century ago. He still refers with pride to the first active Soil Conservation District in the world being set up in his home county. He still remembers, with some emotion, how the cords and cords of wood he cut to help pay his way through college were burned up by a brush fire his kid brother lighted to flush out a rabbit. He finally got to college but dropped out after a couple of years to work for more funds to complete his education. He returned in two years to go on to graduation.

Betty, his wife, has tried her best with the ties and the vests and the cuffs. But the man is so very far removed from such things that she has never won the battle. If she had won it, soil conservation might not be nearly as well known—and practiced—as it is today. It took a unique, colorful character to sell the idea so broadly, so rapidly.

Hugh Bennett reminds me of a line the Scottish plowboy, Bobby Burns, once wrote: "A man's a man for a' that and a' that." Bennett certainly is, for all the frills that lesser men must put on to make an impression and be accepted. Big Hugh is quite somebody in his brogans, denim pants, khaki shirt—and Anson County accent—rocking before his fireside at Eight Oaks in Fairfax County, Virginia.

How much of a man is indicated by the public records in the United States Department of Agriculture.

According to those records, he stood before 50,000 cheering farmers in Ohio as the people of that state dedicated a granite monument to "Hugh Hammond Bennett, father of soil conservation."

In 1940, a South American nation

offered him a \$50,000 annual salary to set up and head a permanent conservation program in their country. He turned it down to stay in his American post at \$9,000 a year at the time.

In 1948, the Inter-American Conference of Conservation of Natural Renewable Resources—sponsored by the U. S. State Department and the Pan American Union—recommended him for the Nobel Peace Prize for his "extraordinary services to humanity."

In 1951, President Harry Truman issued a special order to retain Bennett's services a year beyond the civil service retirement law.

A Secretary of Agriculture once honored him in special ceremonies on the grounds of the Washington Monument, presenting a gold medal for meritorious service.

He has been singularly honored by the American Society of Agronomy, the American Society of Agricultural Engineers, the American Association for the Advancement of Science, the American Geographical Society, the American Forestry Association, the National Audubon Society, the Garden Club of America—and, of course, the Soil Conservation Society of America.

He has written guest columns for Drew Pearson and been featured by such journals as *The Saturday Evening Post*, *Farm Journal*, *Country Gentlemen*, and the *Progressive Farmer*.

Each year his birthday is honored by the largest state in Brazil, Sao Paulo, through a special Soil Conservation Day. On April 15, special programs and festivities fill the day, marked with educational lectures, displays, banquets, and announcements of work accomplished on the land and the next year's goals. The *taca Hugh Bennett*—the Hugh Bennett Cup—is presented. Last year it went to *Folha da Nanha*, one of Brazil's outstanding newspapers, for its carefully conducted conservation-education campaign.

He has received honorary degrees



from the University of North Carolina, Columbia University, and Clemson College and the governor of North Carolina once proclaimed a state-wide Hugh Hammond Bennett Conservation Day.

He has even been recognized by *Popular Mechanics Magazine*, not exactly a farm journal, when he was elected to its Hall of Fame as "one of 50 Americans deserving honor of their fellow men for their achievements in the fields of mechanics, the sciences and discovery, and for their contributions to the welfare of mankind during the past half century."

That is one of the interesting things about the man and his works—that is, the impressive variety and diverse interests of the groups that recognized his views and sought his counsel. He had a flair for convincing many different types of people—from farmers to doctors—that he had a message of vital importance to them, right there, right then.

Evidence of his international influence are the 48 nations now working one way or another on their erosion-control problems. Not all of them have set up separate soil conservation agencies, like the U. S. But they all follow principles they learned from SCS in this country and from advice Hugh Bennett gave them when he visited many of their lands.

He has visited nations all over South America, Africa, and Europe by official invitation. And over 400 specialists have visited him from more than 80 different countries.

He has been lost on the Chagres River in Central America and has crash landed on the Congo River in Africa. He has eaten lizards in Colombia, monkeys in Panama, and sheep feet in South Africa. He has nearly lost his life to a Brown Bear in Alaska, while surveying arable possibilities of lands along the routes proposed for the Alaskan Highway.

Even since his retirement nearly eight years ago, he has been invited

to Cuba, Argentina, Brazil, Spain, France, Greece, and Italy for consultation with those governments. In Argentina, in 1957, he delivered the principal address before the Argentina Scientific Society, with a translator standing beside him relaying his words as rapidly as he could speak them. The Argentine people dedicated a whole issue of their magazine, *Amigos del Suelo* (Friends of the Land) to Dr. Bennett's last visit among them.

The nation of Cuba once awarded him the Cuban Order of Merit for the job he did in helping to save their sugar cane industry from disaster when it was hit by the mosaic disease. While advising them on their need for planting their cane only on soil adapted to cane, Bennett heard of a mosaic-resistant hybrid that had been developed in Java.

He learned that samples of the Java hybrid were being grown experimentally in the southern United States. But seed could not be obtained. The experiment station growing the cane would not let out even one seedstalk. Something about "red tape" was involved. But through one of his associates in the Cuban work, a few seedstalks got through to Cuba and helped save a big chunk of their economy.

From what he says, somebody must have gone over the experiment station fence at night and come up with some seed.

Of the hundreds of magazine articles he has written, one of the most widely read was "Acres Are Aces," which appeared in a February, 1943, *Saturday Evening Post*. World War II was at its height. His article was a discussion of the geopolitics of the earth's soil. He pointed out how the total area of the world's food-producing regions was alarmingly small—"only a little more than 11 per cent of all land on the face of the earth."

He made it clear that he was talking about land immediately available for cultivation—not wet lands that require great drainage systems at much



cost. With maps he contrasted the amount of this land available to the United Nations and to the Axis powers. The article aroused so much interest in Congress that he was called before a committee to explain where he got his data.

An Illinois Congressman wanted to know if Bennett's figures had been pulled out of the air. Bennett explained his office would be glad to provide all the documentation in a few days. But the committee chairman instructed him to bring in the evidence by 10 A. M. the next day. Bennett's staff burned the lights all night in the SCS office, boring back into their literature, into their geographical sources, to dig out the points in minute detail.

He returned the next morning with documentary data running out of his pockets. And without any irritation or emotion toward anyone, he answered the questions point by point, satisfying the committee. His evidence, however, was never entered in the Committee report.

Although much emphasis has been put on the simple, down-to-earth traits in Hugh Bennett's approach, any reporter of this man and his works must make one point unmistakably clear: that his bigness—of stature and mind—enabled him to move comfortably in any situation that confronted him. He was as much at home buying country butter at a crossroads store as he was selling soil conservation to a Princeton University assembly.

At Princeton, he was invited to deliver a principal address before the Engineering and Human Affairs Conference of the Princeton University Bi-centennial Conference in October, 1946. And during the same year, Dartmouth invited him to be guest lecturer on their Great Issues series.

His Princeton address, reported widely in the national news magazines of that week, is an eloquent expression of scientific logic. One quote from it indicates that:

"Productive land is much more limited than commonly has been supposed. It occurs only on the surface of the earth, and only on part of this surface. It is not permanent. Once the fertile topsoil is washed or blown away, it cannot be restored or replaced in any practical way for generations. And what is left—subsoil—usually is far less productive, or sterile, and less stable. There are no undiscovered reserves of productive land of any substantial area.

"We cannot dig deeper into the earth and find new productive soil. We cannot pump it from wells, plant it with seeds, or dig it from mines. We must keep what we have or do without. Assorted residues of sand and gravel left stranded along streamways are of small value.

"Productive land is the only natural resource without which we cannot live. We are completely dependent on it for the food we eat, except fish. We also depend on it for a very large share of our clothing and shelter. We cannot get enough to feed ourselves or provide our clothing from the oceans. On any large scale, hydroponics would be utterly impractical. We might conceivably turn sometime to some form of synthetic food, as pills, plus roughage, but this appears to be a fantastic extreme, still far away, and likely, if it ever comes, it will be decidedly unpopular."

In that same address, nearly 13 years ago at Princeton, he made a prediction that has become rather common talk among agricultural leaders of today:

"Farming will become an expert profession; the inexperienced and inept will be forced off the land. It is not impossible that the prospective farmer of the future will be required to satisfy society that he is qualified by training and experience to take the trusteeship of a piece of productive land."

While he could do that at Princeton, he could hop up on the wheel of a manure spreader and tell a group of



farmers about conservation in language as earthy as the dirt they were standing in—using his best southern drawl to talk about that “powerful po’ h soil” and “those powerful po’ h people.”

Jonathan Daniels, editor of the widely influential Raleigh (N. C.) *News and Observer* and long-time champion of soil conservation work, once told a North Carolina audience that Hugh Bennett violated every rule of elocution he had ever known. But, he added, Bennett never failed to get his message across.

Sometimes, in putting across that message, he was accused of coloring the facts to alarm people into action and of seeking the limelight for himself. Neither accusation was true.

He didn’t have to color any facts. They were already colored—red, yellow, brown, mud-tinted topsoil washing away atop the flood waters of countless creeks and rivers.

A classic example, which he milked as fully as Will Rogers would milk a joke, was Providence Cave down in Stewart County, Georgia—a master gully that had started from drips of water off the roof of a barn. By the time Big Hugh came upon it, the gully was nearly 200 feet deep, washing thousands of acres of good Georgia land down the Chattahoochee River.

He never sought any limelight for himself. Conservation, not Bennett, was his everlasting theme. The record speaks for itself. He was called the chief, but title meant nothing to him. Conservation was his gospel. And because of that attitude, the late Louis Bromfield called Bennett “one of the great men of history to whom this nation and the whole world owes an eternal debt.”

Big Hugh no longer jumps into fast action at some major demonstration on a clean green hillside in Ohio. He is no longer in a rush to catch a plane that will get him to Iowa in time to talk soil conservation to 100,000 people in a bright Midwest cornfield.

Although his pace has slowed some-

what, his interest in the seemingly perpetual Farm Problem remains keen. Of that problem, he said:

“It’s not all economics. It’s a land-use problem, too. Our farmers must use their land in accordance to the kind of land they have and the condition it is in from the way it has been used.

“Instead of moving ‘marginal farmers’ off the land, why not move farmers off *marginal land* onto better land or into more rewarding activity.

“Instead of using top quality farm land for roads, buildings, air strips, and parks, why not use, where possible, some of the nonarable land.

“I may sound like a chronic alarmist, but mark these words: As our population increases 30 million extra mouths to feed every 10 years and our arable land declines 30 million acres every 10 years, we may have a real farm problem by 1980 or 1990 if we don’t start using more science and wasting less time and money on theories and assumptions.”

In the days before most farmers knew what the word *surplus* meant and population figures were of small concern, Dr. Bennett was riding along a washed out back road in Georgia when he came upon a Negro farmer sitting with his feet hanging over a fence on the edge of a watermelon patch. The patch was full of weeds. Bennett told the man he’d better be cleaning up those weeds if he wanted any melons.

The man replied, “I’ze jest been settin’ here figurin’ on them weeds.”

What he was “figurin’” will forever be known only to him. But the fact he was “figurin’” was encouraging, Bennett contends.

Perhaps that’s what it takes to get the message of agriculture across to the public. Figurin’—with science, farmers, publicity, and Congress. Figurin’, that is, in a down-to-earth way.

At least, Hugh Bennett did it that way. And history is already shining on him.





The lady was stepping from the shower and was about to reach for a towel when she caught sight of a window washer looking through the window at her. She was too stunned to move, just staring at the man.

"Whatcha lookin' at, lady," he finally asked. "Aincha never seen a window washer before?"

Two rabbits were being chased by a pack of dogs when one turned to the other and said:

"What are we running for, let's stop and outnumber them."

"Keep running, keep running," yelled the other one. "We're brothers."

News item in an Iowa newspaper: "Local police are puzzled over the finding of a car parked in a lonely neighborhood containing a full case of Scotch whiskey. So far they have found no trace of the owner, but Captain Grady is working hard on the case."

"I'm not wealthy and I don't have a yacht and a convertible like Jerome Green," apologized the suitor. "But, I love you."

"And I love you, too," replied the girl. "But tell me more about Jerome."

Police Officer: "Hey, slow down that truck. Don't you have a governor on it?"

Bewildered truck driver: "Governor? No sir. He's back at the Capitol. That's fertilizer you smell."

Although after years of evolution man has learned to walk in an upright position, his eyes still swing from limb to limb.

"Darling, haven't I always given you my salary cheque the first of every month?"

"Yes, but you never told me you got paid twice a month—you low-down, unprincipled embezzler."

Politics is the art of obtaining money from the rich and votes from the poor on the pretext of protecting each from the other.

Think how a mother kangaroo must feel on a rainy day when the kids can't play outside.

"What's the matter with you?" the wife demanded. "Monday you liked beans. Tuesday you liked beans, Wednesday you liked beans; now Thursday, all of a sudden, you don't like beans."

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CONFERENCE: A place where conversation is substituted for the dreariness of labor and the loneliness of thought.

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# 246 BUSHEL OF GRAIN SORGHUM PER ACRE

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THE LIMITING FACTORS ARE TAKEN CARE OF

WHERE.....	Purdue Agronomy Farm, Lafayette, Indiana
WHO.....	Dr. R. C. Pickett, plant breeder, Department of Agronomy
YIELD.....	246 bu. per acre (13,773 lbs.) 13% H <sub>2</sub> O
VARIETY.....	Hybrid RS610
PLANTING RATE.....	Fifteen pounds per acre
ROW WIDTH.....	Seven inches—planted with a grain drill
WEED CONTROL.....	Pre-emergence chemical treatment which achieved the most weed-free plots
PRECEDING CROP.....	Soybeans
SOIL TYPE.....	Toronto silt loam, a moderately dark colored imperfectly drained prairie-forest soil. This was cleared in 1953.
SOIL TEST.....	pH 6.2, medium in P, low in K
FERTILIZATION.....	Plowed down 300 lbs. per acre muriate of potash and 100 lbs. N. Drilled 100 lbs. 20-52-0 before planting.
PLOTS.....	Three replications eight feet by 30 feet (30 ft. of row harvested)

Work at Purdue over the past 3 years indicates that yields exceeding 200 bushels per acre can be expected regularly—when there is adequate moisture, relatively high fertility, high planting rates of new hybrids, 15-20 lbs. of seed in close rows (7"), and weed-free conditions.



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