# Better Crops WITH PLANT FOOD

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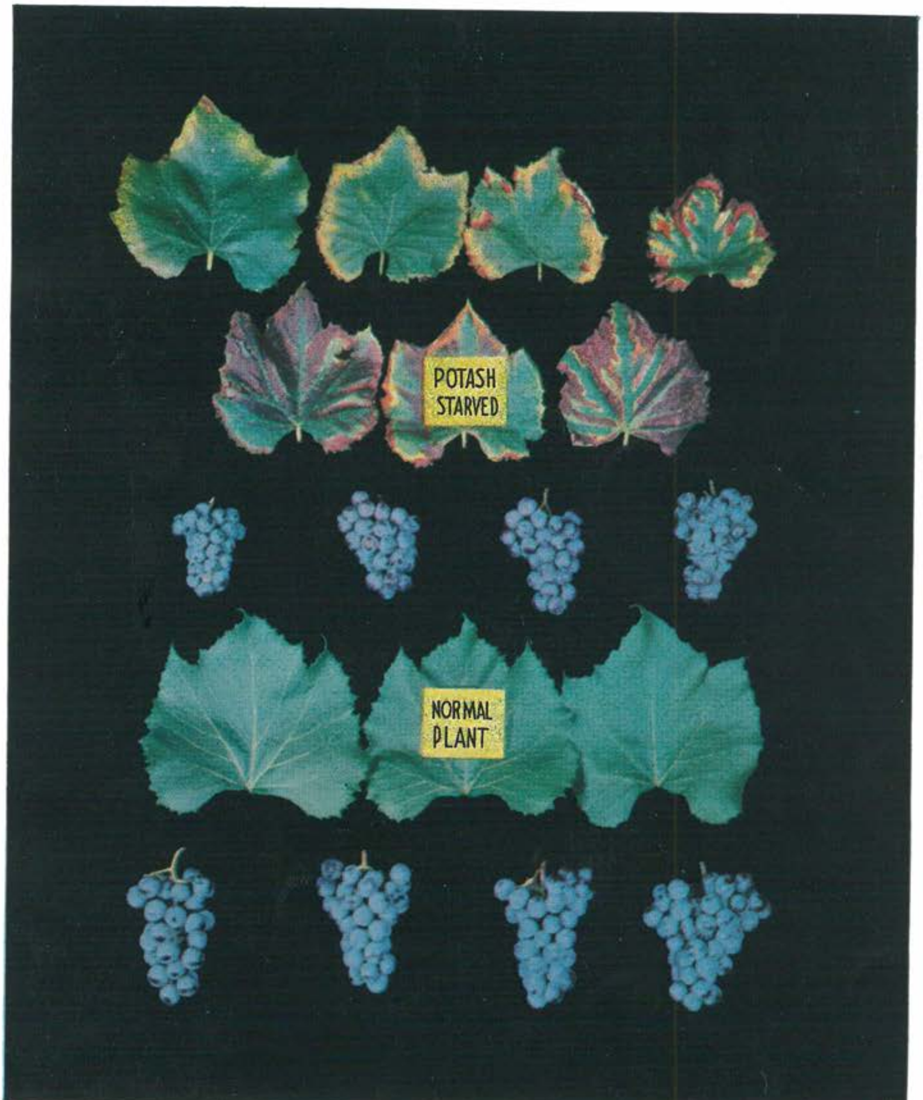


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The Pocket Book of Agriculture

# Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

*Editorial Office:* 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXIX NO. 2

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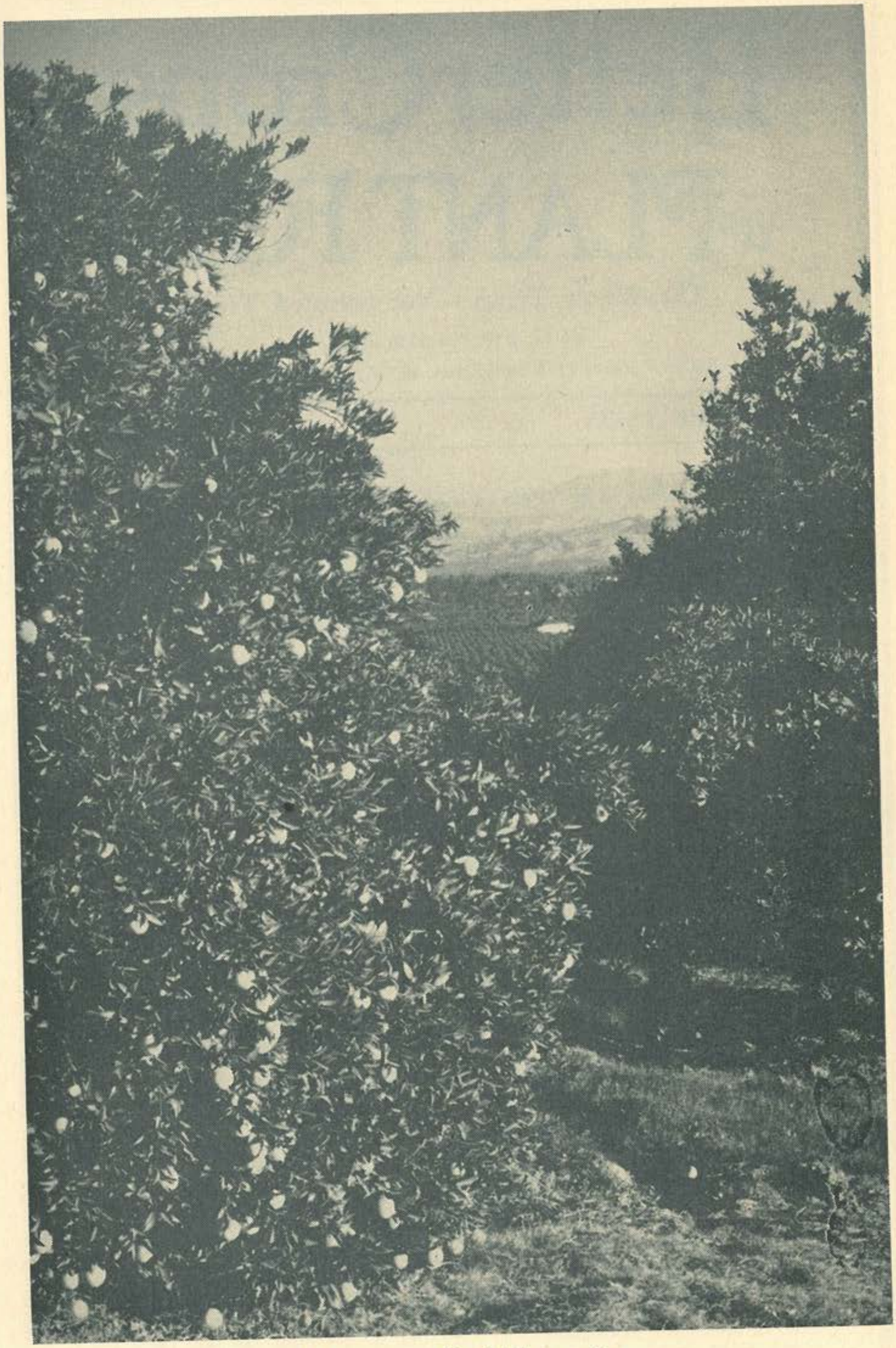

Sunny California

Better Crops
with PLANT FOOD

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VOL. XXXIX WASHINGTON, D. C., FEBRUARY 1955 No. 2

***Science Has Produced . . .***

# Formula Farming

Jeff McDermid

IT'S a consolation to me that some others know more about chemistry than the rest of us, and that they applied their cabalistic formulas finally to the problems and pests of agriculture. Otherwise, we would still be slapping beetles off potato vines with a lath, collecting houseflies on sticky paper, and painting the crevices of a bed with kerosene. And were it not for the Bunsen burner boys with the dichlorophenoxyacetic vocabulary, the No. 1 man in the whole picture —the farmer—would have some things far more dismal to fret over than floods, drought, sheep-killing dogs, and the parity level.

Agriculture is outdoing the mystery that enthralled the readers of the Arabian Nights. Once they believed in the art of the alchemist and talked of "phlogiston" in connection with scientific crop production and soil management. But today it's nothing less than the same old genii in the form of genius, rubbing up some complex compounds to give all farmers the potent powers of Aladdin with his wand-waving "presto changeo" and "abracadabra."

Few but the highly trained college farmers begin to pretend they understand it. The erudite editors of farm publications are themselves in general but poorly prepared to call forth these chemical wonder-workers and explain their action. Every spring they draft experts in entomology, plant pathology, chemistry, and agronomy to recommend what farmers should use out of the ever-growing lists of laboratory concoctions.

This spring is no exception. Here a Midwest extension bug fighter has his say-so in a recent farm journal. He began with a brief review of what the experts call "chlorinated hydrocarbons" that contain both old and new insecticides.

Beginning with the old favorite, first of the modern insect destroyers—DDT, he lists chlordane, BHC and lindane, toxaphene, methoxychlor. These are the steady performers, the compounds that seem to have established their places. Along with these, he names others that are somewhat newer, such as aldrin, endrin, dieldrin, and heptachlor.

New uses for many of these chemicals are recounted also, such as for seed treatment against maggots and other boring insects, and for widespread control of numerous soil-borne bugs. In another fascinating group the writer gives farmers the low-down on some of the most powerful and toxic organic phosphates. Sometimes they are absorbed by plants and taken into the tissues and carried there in enough strength to kill sucking insects which nibble and gnaw on the growing vegetation.

SUCH organics are known, he says as systemic poisons. Mostly their use is on cotton and ornamentals. At least two of them, he advises, are used on vegetables to control aphids and mites—Schradan and Systox. Malathion with low poisonous effect on man and animals is a bitter foe of flies, scale, and caterpillars. Diazinon, he says, is more poisonous to man but great guns to stop flies and it lasts several times longer than others in its class. He reviews field tests with two other such compounds newly introduced, but not yet offered to farmers in any amount. These are chlorthion and pyrazion. Quite a difference, is it not, from our old-time main reliance upon paris green, which we slopped on with an old rusty watering pot or a stiff brush and a 10-quart bucket?

Then we page Mr. Fungicide Foiler, who tells how bordeaux mixture and lime-sulfur are back numbers now since 1941 when the original antibiotic, penicillin, was isolated from a certain fungus. Antibiotics, too, seem to act as a systemic disease fighter inside of the plant to which they are fed. The best progress made recently in checking plant diseases with these drugs is the discovery that a few microorganisms produce antibiotics that can kill or limit the action of fungous diseases. All of the main ones longest used act as bacteria barriers instead of being valuable against fungi. Some of the most promising of these battlers that seem to lick fungi and viruses are known as "helixin," "toximycin," "antimycin," and "thiolution."

To make these tough babies even worse enemies of the plant disease family, they add certain plant growth regulators such as 'indoleacetic acid." Then we often hear seasonal discussions in the field of cotton defoliation as an aid to the maturity and harvesting ease of the crop in the South. These include such technical names as "calcium cyanamide" and "amino triazol." Besides, the whole field of weed eradication has been invaded by chemical control methods with a language all its own—making the old-time terms almost as archaic as the hoe.

ALL this means far greater security against the old foes and pests we could never quite conquer or subdue. It also means a heap of queer and dizzy scientific words that only the expert and the manufacturers are able to roll off their tongues and keep them separate and well behaved. Your county agents will back me up when I say that chemicals for crop protection and livestock sanitation, and for home and stable application, are now just as important to farming as the plow, the combine, and the electric power line.

The general public doesn't realize the great role that the chemist and his technology play in getting better quality into farm products and to some extent saving labor and time. You see the combine and the power plows and all the other mechanical accoutrements with which the farmer multiplies his individual efforts. But the decisive action of detergents, adhesives, weed killers, plant hormones, trace elements, and antibiotics are very little in evidence by comparison to the bulky and noisy machines so indispensable to agriculture today.

Few know that the discovery and application of chemical methods and substances in all the specialized fields of farming and stock raising have actually spread much faster than the introduction and adoption of improved machinery. We have had mechanical marvels and gadgets to speed the plow and lift the burden from routine farming for over half a century. But the

actual chemical era in agriculture has dawned and risen to its present unique place within the span of 20 years or less. Figures have been cited by authorities to convince us that this is true.

Taking the 1935-36 period as 100, the situation in 1950 indicated that while all manufactured products stood at 210, and general chemical products at 265, the position of chemicals made for industry and agriculture zoomed up to 455. By this time no doubt the upward stretch has sent these applied chemicals for farm and factory beyond the 500 index.

The oldest of human arts and professions is going through a revolutionary change by reason of the new chemistry it is fast absorbing into its everyday life. The times ahead are ripe with promise of food and fiber in plentiful supply, but it may carry with it some grave problems of a social and economic kind for which we must be well prepared.

About the time that our farm friends in the East decided that eternally pushing their way westward to fresh lands was at an end, it became clear that new frontiers in skill and improved methods was destined to replace the wanderlust and speculation of the prairie schooner days. So presently we saw the establishment of our system of agricultural trial and error centered in the experiment stations.

THIS soon led to the birth of agricultural chemistry. Looking back, we recall that the first achievements credited to agricultural chemistry related to plants, soils, and artificial fertilizers. We all remember how few of our neighbors were originally willing to lay aside the manure fork to invest in plant foods coming to them in bags. But some of them used commercial mineral plant foods even at the turn of the century, possibly, if the records are straight, about fifty million dollars' worth of it. By 1950, farmers were investing as much as 900 million dollars a year for chemical menus for hungry plants on unbalanced soils.

Every year the fear that we will run short of fertilizer is quickly dispelled by authorities who hasten to reassure anxious farmers about new production units and more potent formulas. Telling a farmer these days that he ought to use fertilizer chemicals is like advising a baker he ought to use flour.

So up until about 15 years ago, agricultural research was centered mostly on aiding the physiological processes in plants and animals in the ordinary, routine ways with fertilizers for soils and better feeds for livestock. In doing this, use was made of materials already at hand. New synthetic combinations were unknown. That is to say, the scientists of the recent past went a good step further. They used some imagination, after bumping headlong into some results in the laboratory and the test plots that did not square up with ordinary chemical experiences.

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Fig. 1. More bales per acre, marketed properly, mean more net profit per hour of labor.

# Seven Steps to Good Cotton


*By T. M. Waller*[1]

Department of Agronomy, Mississippi State College, State College, Mississippi


COTTON has been, and still is, the main source of farm cash income in Mississippi. Sales of lint and seed amounted to 57% of the State's farm income in 1947-51, and was 74% in 1954. Bankers still finance crop production based on the number of acres planted to cotton on the farm. In good cotton years like 1925, 1937, 1948, and 1953, everyone—farmers, laborers, grocerymen, implement dealers, teachers, lawyers, doctors, and others—had money to spend.

In 1930, Mississippi farmers planted 4.1 million acres to cotton. The production that year was 1.4 million bales, averaging 168 pounds of lint per acre. It required 3 acres to produce 1 bale. The cotton sold for 6¢ per pound of lint. An average for the last 6 years, 1949-1954 shows 2.3 million acres planted to cotton produced 1.67 million bales, and 345 pounds of lint per acre. Five-Acre Cotton demonstrators grew 867 pounds of lint per acre.

The 1930 era in the State's history helped people to understand that a one-crop system of keeping the land clean depleted the soils and greatly contributed to the low farm income. The cotton itself removed less total minerals from the soil than was removed by corn, oats, and hay crops. However, the clean system of cultivation kept the cotton fields bare during high rainfall seasons of the year and, consequently, the soils eroded.

[1] Illustrations courtesy Mississippi Extension Editorial Department.

**Fig. 2. Average yields per acre of cotton were low due to failure on the part of 85% of the farmers in Mississippi to make use of all recommended improved practices from 1928 to 1933.**

### A New Plan for Cotton

In 1948, the author, serving in his present capacity, met with 42 representatives of research, education, and industry to get approval of a new plan for the use of all research in cotton production. Prior to this meeting, cotton research information available in Mississippi was analyzed and written into the new program, namely, "SEVEN STEPS TO MORE COTTON, MORE MONEY:"

1—Fit Cotton Into a Balanced Farm Program;
2—Take Care of Your Soil;
3—Get Together on the Best Local Variety;
4—Make Your Labor and Equipment Count;
5—Control Diseases and Insects;
6—Pick and Gin for High Grade;
7—Market for Grade, Staple, and Variety Value—Stimulate Consumer Interest in the Use of Cotton Products.

It was pointed out that Mississippi farmers were not using in their annual production all the known cotton research available. It was also shown that if this program were followed in its entirety by Mississippi farmers, cotton yields would be doubled or tripled in the very near future.

Sixteen Mississippi organizations representing those industries interested in having cotton remain a source of farm income voted to finance a 5-Acre Cotton Contest in the amount of $5,000 per year. The contest was designed to serve as an incentive to cotton farmers and county agricultural workers to demonstrate the use of all SEVEN of the recommended improved practices. During the past 6 years it has definitely proved through hundreds of these demonstrations that a complete cotton production program will double the yield per acre.

#### *First Step*—Fit Cotton Into a Balanced Farm Program

Mississippi cotton farmers are now making plans to plant their 1955 acreage allotment on the most productive land on the farm. They also are fitting cotton into a balanced farm program. Those acres taken out of cotton since 1930 have been planted to pastures, corn, oats, soybeans, rice, truck crops,

Fig. 3. Carmen Massey, Lyons, Mississippi, pointing out to his father that a complete production plan produced 3 bales per acre on his 5-acre plot in 1949.

and timber. Such combinations of enterprises as cotton-dairy, cotton-livestock, and cotton-truck have returned highest net income per worker.

Managerial skills are necessary for successful operation of a complete cotton production program. Farmers who developed these skills produced an average of twice more per acre than other farmers.

### *Second Step*—Take Care of Your Soil

This step is emphasized the year round. A balance of minerals is a very important factor in growing

Fig. 4. Central Mississippi cotton farmer's failure to plant winter cover crops, follow a crop rotation, and to maintain terraces let soil erosion ruin good farm land prior to 1948.

higher yields of cotton per acre. Soil testing indicates the need for lime, phosphate, and potash in each field studied. Through soil testing a complete fertilization program is made possible.

In 1930, farmers in the Mississippi Delta were using 30 pounds of nitrogen per acre. In the Hill area of the State farmers used an average of 287 pounds per acre of mixed fertilizer, 4-8-4, and sidedressed with 15 to 20 pounds of nitrogen per acre. Lime was not being used under cotton to any extent.

Cotton farmers could not make 2 bales per acre on land testing pH 5 and below, even if they doubled their fertilizer rate per acre. Research shows that on acid soils of pH 5 or lower, the phosphate ($P_2O_5$) is tied up and it requires twice as much $P_2O_5$ to get the same yield obtained on a soil testing pH 6.5.

Many farmers applied three times the normal rate of fertilizers per acre without liming, and the cotton developed "crazy leaf" or manganese toxicity. Liming the soil corrected the trouble for the next crop. This is one very important reason why cotton yields from 1930 to 1948 were low on the acreage planted in the Hill area. On the average, Hill farmers plant one-half the cotton acreage in Mississippi. About 35% of this acreage is planted on hill land with varying degrees of slope, which causes water to become a limiting factor in high yields per acre.

To produce stalks, roots, leaves, burrs, seed, and fiber for a 500-pound bale of lint cotton, 72 pounds of nitrogen, 48 pounds of $P_2O_5$, and 48 pounds of $K_2O$ are needed. Mississippi research over a period of years shows that 600 pounds of a 6-8-8 mixed fertilizer or its equivalent placed 6 to 8 inches deep in the seedbed before planting, followed with a sidedressing of 36 pounds of nitrogen, give most economical yields per acre. Higher or lower rates of fertilizers are recommended, based on findings of the soil test. Nitrogen is needed on all soils in the State for maximum cotton yields. Potash is required for maximum cotton production on 60 to 75% of the Mississippi soils.

Mississippi farmers have saved their topsoil on slopes by proper terracing. Rainfall was trapped and allowed to soak in for late summer use. Subsoiling where a man-made plow sole or shallow

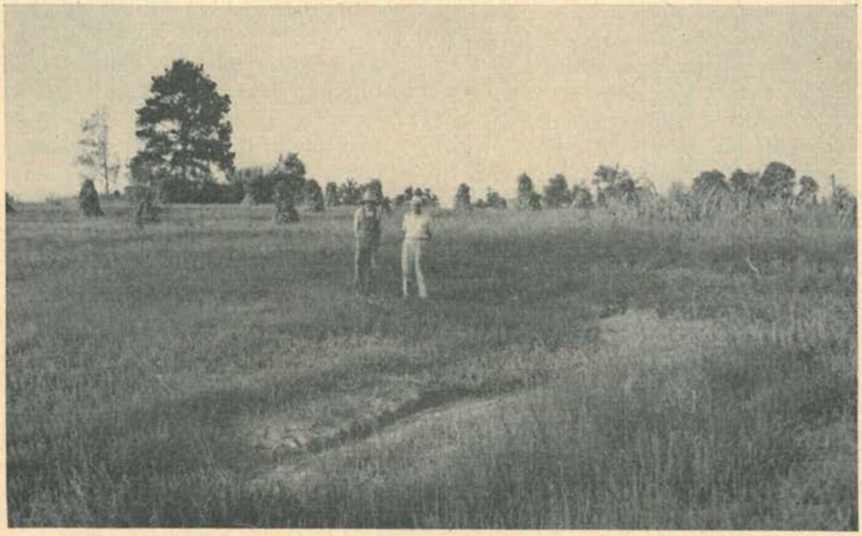

**Fig. 5. (Compare with Fig. 4) A balanced farm program of cotton and livestock was adopted by this farmer in 1948, and 2 years later this field was just about cured through good land use.**

**Fig. 6. A balance of minerals, deep breaking, seed treatment, sufficient moisture, and thrip control enable cotton plant roots to penetrate the soil. Higher yields per acre result.**

natural hardpan existed allowed additional water to penetrate the subsoil. One-fourth to three-fourths bale of lint per acre has been reported by both research and 5-Acre Cotton demonstrators, as a result of subsoiling 10 to 23 inches deep. Deep breaking should be done in the fall when subsoil is dry.

The use of such systems as vetch and wild winter peas planted in the fall on heavy clay soils, a seed crop harvested in the spring, and the residue left to rot on top of the ground, with only enough disking to keep down weeds in late summer, increased yields ¼ to ½ bale per acre. Old pastures, 5 to 6 years old, plowed under and planted to cotton, increased yields ¾ to 1 bale per acre. Organic matter is very important in improving the tilth of the soil. Highest yields of lint cotton are obtained on soils high in both humus and organic matter.

Moisture is another very important production factor. Subsoil moisture can be built up through terracing (controlling the rate of flow of rain water), subsoiling where needed, crop rotation with broadcast crops, winter cover and summer legume crops, and by fallowing or letting a field rest.

During the past 6 years we have had 2 extremely wet years and 4 severely drouthy years. Supplemental irrigation has played an important part where water was available. Yields have been increased by 1 to 2 bales per acre under good irrigation management. Cotton is a tropical plant and can stand a lot of water during its growing period. Twenty-one days after the bloom is fully open, the size of seed and length of the fiber are completed. The amount of subsoil moisture stored in the soil from December through March influences the development of the seed and fiber in July and early August. Those soils containing a maximum of balanced minerals needed by the cotton plant produce highest yields under these conditions.

The amount of rainfall or showers received in late July and early August also determines whether Mississippi cotton farmers pick a top crop. In 1952, no general rains came in July; the top crop was shed. In 1953, local rains supplied additional soil moisture and the best top crop since 1948 was harvested.

### *Third Step*—Get Together on the Best Local Variety

Management, minerals, moisture, and the deepest phase of productive soils are not the complete story for highest economical yields per acre. Step three is a very important phase of the complete cotton production program. The kind of cottonseed planted determines the characteristics or kind of fibers (lint) the ginner wraps in the bale. The cotton farmers are the important link between the cotton breeders and the textile mills or spinners.

For years, the 1-10-100 seed increase plan has helped Mississippi cotton meet keen competition of other production areas in the United States and foreign countries. This plan has been responsible for eliminating many of the 16 different varieties of cotton that were

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# Apparent Fertility Trends in Western Irrigated Soils

*By H. D. Chapman*

Department of Soils and Plant Nutrition, University of California, Riverside, California

IN our absorption with the problem of securing maximum production of high quality produce at lowest cost, many of us are forgetting about the preservation of soil productivity and the long-time impact of irrigation waters, fertilizers, fungicides, cropping practices, and management on our soils.

During a trip to Europe, India, and the Orient in 1952 I was deeply impressed as are all agriculturists, by two observations:

1. The great scarcity of currently usable soil resources in relation to population in many areas, and the prodigious effort expended in building terraces and in reclaiming soil from the sea to meet or help meet human needs.
2. The hundreds of years that many of these areas have been and must be farmed, how young in comparison are our farming areas, how profligate we have been with them, and how urgent it is for us to preserve at all costs these necessary resources.

These observations, coupled with the poverty so evident in many of these areas, served to focus my attention and make me acutely conscious of our precious resource, the soil, and the importance not alone of trying to find ways and means of securing maximum production now, but of maintaining soil productivity for our future generations.

Some indications of long-time chemical trends under irrigation agriculture are furnished by a lysimeter experiment which we have had under way at this station for nearly 20 years. Everything that goes on in the soil of this experiment by way of irrigation water, rain, fertilizer, seed, and organic matter is measured as is everything removed by leaching and crop removal. With an inventory of the chemical constitution of the soil at the outset and checking these at periodic intervals, we have been able to measure the net gain or loss of various of the major nutrients for all of this period. The results of the first 15 years of this experiment on gains, losses, and balance of nutrients in this soil are shown in Table I. These results are striking, especially when considered in the light of the short space of 15 years as compared with the hundreds of years we must continue to farm our soils.

***Calcium***—They show for calcium a substantial gain, amounting to some 413 pounds per acre per year. In part, this calcium has come from the consistent use of calcium nitrate fertilizer. However, the gain from the latter would amount to less than half of that found. The rest has come from the irrigation water.

***Magnesium***—The amounts of magnesium added in irrigation water just about balance the magnesium lost by leaching and by crop removal. There is a slight loss. This might be greater, of course, under other types of cropping and leaching conditions.

***Potassium***—With reference to potassium, the picture is striking. Here

TABLE I.—TREND OF FERTILITY IN AN IRRIGATED SOIL—CROPPED TO SUDAN GRASS ANNUALLY AND FERTILIZED AT THE RATE OF 200 LBS. CALCIUM NITRATE PER ACRE.

| Element | Total gain or loss in 15 yrs. lbs/acre | Gain or loss per year lbs/acre |
|---|---|---|
| Calcium | + 6,189 | +413.0 |
| Magnesium | − 17 | − 1.1 |
| Potassium | − 3,552 | −236.0 |
| Sodium | + 1,913 | +127.0 |
| Nitrogen | − 724 | − 48.2 |
| Phosphorus | − 227 | − 15.1 |
| Sulfur | + 399 | + 26.8 |
| Chlorine | + 119 | + 7.9 |
| Bicarbonate | +12,203 | +815.0 |

there has been a net annual loss of 236 pounds of potassium per acre per year. Though the total lost amounts to but 1% of the total potassium of the soil, it indicates clearly that sooner or later soils to which potassium is not restored by fertilization, even though initially rich in this element, are going to require the addition of potassium fertilizer.

***Sodium***—With sodium there has been a net gain. This stems entirely from the sodium contained in the water. The irrigation water used in this experiment was a low salt containing mountain water but neither crop removal nor leaching loss has been sufficient to subtract that added in the irrigation water.

***Nitrogen***—In the case of nitrogen, despite the fact that 200 pounds of this element were added annually, there has been, in addition, a net loss of 48.2 pounds per acre unaccounted for, thus, the total net disappearance is 248.2 pounds per year.

***Phosphorus***—There has been a net loss of 15.1 pounds of phosphorus per acre per year.

***Sulfur***—With sulfur, there was a net gain of 26.8 pounds per acre. As with sodium, this was due to the sulfate in the irrigation water.

***Chlorine***—In the case of chlorine, there was also a net gain, though it was rather small.

***Bicarbonate***—With reference to bicarbonate, there was a very large gain. This constituent came entirely from the bicarbonate of the irrigation water. When added to soils, a part of it, that in the calcium form, goes to insoluble calcium carbonate and a part remains undoubtedly as sodium bicarbonate. The pH of this soil has changed in the short space of 15 years under irrigation agriculture from pH 6.6 to pH 7.9.

These data set me to thinking about our current fertilizer practices in Western States and I have assembled in Table II acreage and average fertilizer usage data for fruits and vegetables in

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TABLE II.—ACREAGE AND AVERAGE FERTILIZER USE ON FRUITS AND VEGETABLES IN 10 WESTERN STATES[1]

| Crop | Acreage | N | | $P_2O_5$ | | $K_2O$ | |
|---|---|---|---|---|---|---|---|
| | | Tons | Av. lbs. per acre | Tons | Av. lbs. per acre | Tons | Av. lbs. per acre |
| Fruits | 1,897,000 | 55,133 | 58.1 | 7,719 | 8.1 | 891 | 0.9 |
| Vegetables | 1,001,000 | 28,040 | 56.0 | 21,845 | 43.6 | 7,835 | 15.6 |

[1]Washington, Oregon, Idaho, Montana, Colorado, Utah, Nevada, California, Arizona, New Mexico.

Data taken from Report No. 4 of The Fertilizer Work Group, National Soil and Fertilizer Research Committee. August 1951. Mimeographed.

# Shortages of Potash Limit Michigan Grape Yields

*By R. Paul Larsen, A. L. Kenworthy, and Harry K. Bell**

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SHORTAGES of potassium are appreciably reducing yields of Concord grapes in Michigan, according to recent studies. A survey of the principal grape producing areas of Michigan conducted during 1953 and 1954 indicates that 65 per cent of the Concord vineyards may be suffering from potassium shortages. Fertilizer plots comparing different amounts of potash applied indicated that yields could be significantly increased the year of initial application in vineyards where potassium previously was very low.

Although isolated instances of potash deficiencies had been found in Michigan vineyards prior to the recent survey, potash levels were assumed to be adequate in most instances. In early experiments in southwestern Michigan, Partridge (1923) found that applications of potash failed to increase vine growth and fruit yield. Furthermore, the applications had no effects on time of fruit maturity nor on the percentage of soluble solids in the fruit. In fact, Partridge and Veatch (1931) stated that the depth of the humus layer of

* Photos by H. L. Garrard.

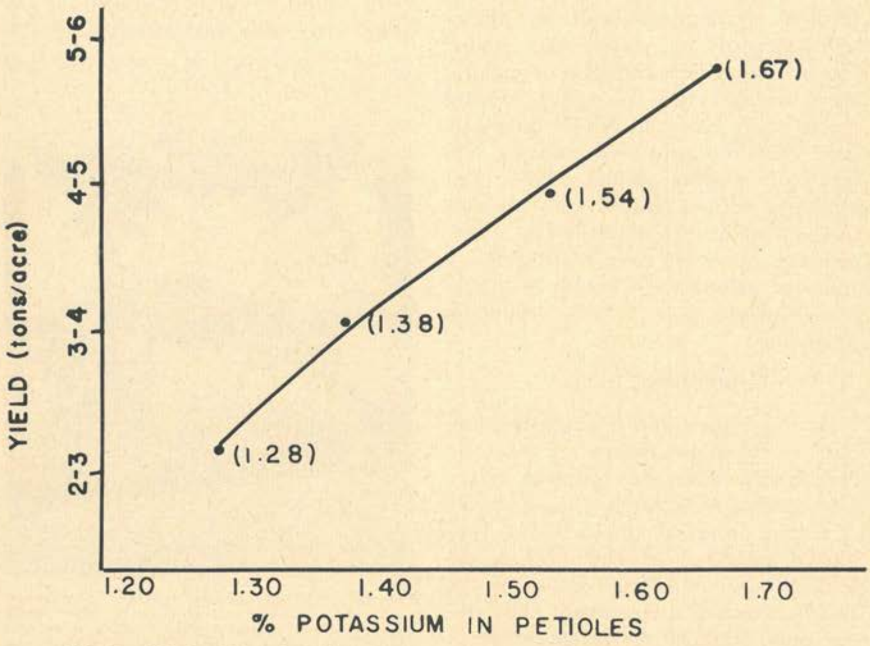


**Fig. 1. Relationships of yield and per cent potassium (K) in grape leaf petioles.**


Fig. 2. With 180 lbs. $K_2O$ per acre, vines had good vigor and produced large, well-colored fruit clusters. No leaf scorch apparent. 1.26% K in leaf petioles. Grape fertilizer plots, Kalamazoo, Mich., Sept. 20, 1954.

the surface soil had a greater influence on vine growth and production than any fertilizer practice that they studied. As a consequence of these findings, fertilizer recommendations for Michigan vineyards for many years tended toward use of only nitrogen or manure when the latter was available. During recent years, however, N-P-K fertilizers have been recommended, and the majority of growers annually have been applying various grades and amounts of so-called "complete fertilizers." Few growers, however, have been applying suffcient quantities of potash to supply the demands of a heavily producing grapevine.

### Nutritional Survey

At the request and through the support of Michigan grape growers, in conjunction with the National Grape Cooperative Association, Inc., a survey of several Concord vineyards was conducted during 1953 and 1954 to determine the nutritional status of the State's principal grape areas. The survey was designed to locate areas of actual or potential nutrient element shortages as an aid in improving fertilizer recommendations.

During July and early August of each year, soil and leaf petiole samples were taken from 10 vines in sections of each of 62 vineyards located primarily in southwestern Michigan. Petiole samples were found to be a reliable index of the nutritional condition of the grapevine. The use of petiole samples also eliminated certain difficulties encountered in the preparation of leaf blades for analyses. In mid-September vines in the same sections were harvested to determine fruit yields and for determination of soluble solids and titratable acidity. Information was obtained from each grower in regard to present and past cultural practices and vineyard performance.

### *Potash-deficiency Symptoms Observed in Field*

One of the most noticeable and striking features seen in many vineyards during the survey was the occurrence of a marginal and interveinal chlorosis on leaves. These symptoms were found to be widespread in the grape areas and were especially preva-


Fig. 3. Without potash, typical vine showed low vigor, excessive leaf scorch, and small, poorly-colored clusters. Only 0.21% K in leaf petioles. Grape fertilizer plots, Kalamazoo, Mich., Sept. 20, 1954.


**Fig. 4. With only 90 lbs. $K_2O$ applied, vigor was improved somewhat, but leaves showed some marginal yellowing and scorch. Only 0.32% K in leaf petioles. Compare with Figs. 2 and 3. Grape fertilizer plots, Kalamazoo, Mich., Sept. 20, 1954.**

lent in vineyards located on light-textured soils. The first symptom to be observed appeared in mid-July as a slight marginal discoloration of the leaf. As the season progressed, the symptoms became more apparent, varying from a slight marginal chlorosis to a severe marginal and interveinal chlorosis, which by harvest time often had advanced to a necrosis and crinkling of the leaf (see cover). Petiole analyses confirmed that these symptoms were due to a deficiency of potassium. Although widespread potassium deficiency previously had not been suspected, it was apparent from visual observations that many vineyards were suffering from a shortage of this element. It was suspected also that many vineyards were suffering from deficiencies of potassium even though symptoms were not apparent on the leaves.

### *Petiole Analysis Confirms Field Observations*

Petiole and soil analyses revealed that shortages of potassium were widespread throughout Michigan's grape producing areas. Furthermore, it was noted that where this condition existed, grape yields were reduced appreciably. When the data were grouped in regard to yield, it was apparent that a definite relationship existed between the potassium in petioles and yield (Fig. 1). Thus, as fruit yields increased from less than three tons per acre to between five and six tons per acre, there were corresponding increases in petiole potassium from 1.28 to 1.67 per cent dry weight (Table I).

Vigorous, healthy-appearing vineyards which produced over four tons of grapes per acre had petioles with potassium values which averaged 1.99 per cent on a dry weight basis. This potassium value was selected as a tentative standard for petioles from all vineyards included in the study. On the basis of this value it appeared that even many of the higher-producing vineyards would benefit if additional potash were applied. Potash-deficiency symptoms generally were found where there was less than 0.75 per cent potassium

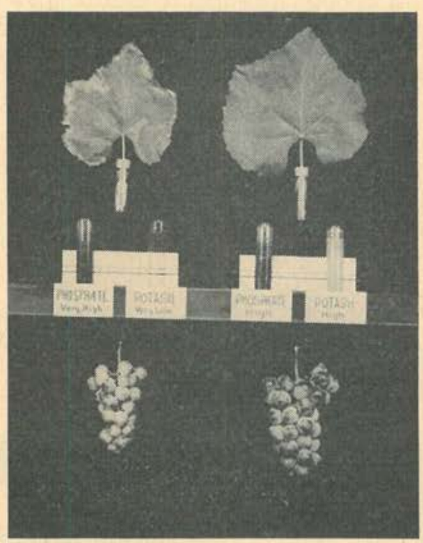

**Fig. 5. Tissue tests of grape leaf petioles showed very low potash but very high phosphates on the no-potash plot, left. Both phosphates and potash were high where 180 lbs. $K_2O$ had been applied, right. Purdue modified tissue tests used. Analyses of leaf petioles showed 0.22 and 1.31 per cent K, respectively. Grape fertilizer plots, Lawton, Mich., Aug. 29, 1954.**

TABLE I.—AVERAGE NUTRIENT COMPOSITION OF CONCORD PETIOLES OF FOUR YIELD CLASSES. ALSO, STANDARD VALUES FROM AVERAGES OF HEALTHY, MODERATELY PRODUCING VINEYARDS.

| | Yield (tons per acre) | | | | |
|---|---|---|---|---|---|
| Nutrient | 5–6 | 4–5 | 3–4 | 2–3 | Standard values |
| N, % | 0.81 | 0.80 | 0.73 | 0.83 | 0.81 |
| P, % | 0.24 | 0.33 | 0.29 | 0.47 | 0.31 |
| K, % | 1.67 | 1.54 | 1.38 | 1.28 | 1.99 |
| Ca, % | 1.78 | 1.72 | 1.88 | 1.72 | 1.66 |
| Mg, % | 0.54 | 0.54 | 0.80 | 0.78 | 0.41 |
| Mn, % | 0.05 | 0.09 | 0.18 | 0.04 | 0.06 |
| Fe, ppm | 41 | 45 | 46 | 39 | 39 |
| B, ppm | 30 | 28 | 31 | 29 | 28 |
| Cu, ppm | 23 | 41 | 24 | 48 | 39 |

in the petioles. In one vineyard the petioles contained only 0.16 per cent potassium on a dry weight basis. Deficiency indices were calculated from the standard value and adjusted by coefficient of variation. These indicated that potassium deficiency existed in 65 per cent of the vineyards in the survey.

## *Drought and Potassium Deficiency*

It is generally believed that under dry soil conditions a reduction in the absorption of potassium by the roots of plants may occur. Because of generally low soil moisture conditions in Michigan's grape producing areas during 1953, it was believed that widespread potassium deficiencies prevalent during that season may have been partly due to drought. During the summer of 1954, moisture generally was at a normal or above normal level in most Michigan vineyards; yet a widespread occurrence of potassium-deficiency symptoms was noted. The severity of the symptoms, however, was more pronounced in 1953 than in 1954, indicating that drought may have been a contributing factor in 1953.

## *Other Nutrient Elements*

There was an inverse relationship for potassium with calcium and magnesium as evidenced by the petiole analyses. As the potassium increased, there was a decrease in both calcium and magnesium. Also, similarly, as calcium increased, there was a decrease in magnesium. These relationships among the three major cations (potassium, calcium, and magnesium) normally are expected but were stronger in these grape petioles than has been observed in foliar tissues of other fruit crops.

Amounts and relationships of other nutrient elements (nitrogen, phosphorus, iron, boron, manganese, and copper) in the petioles showed no consistent trends or patterns when the data were grouped according to fruit yield classes. Furthermore, no serious short-

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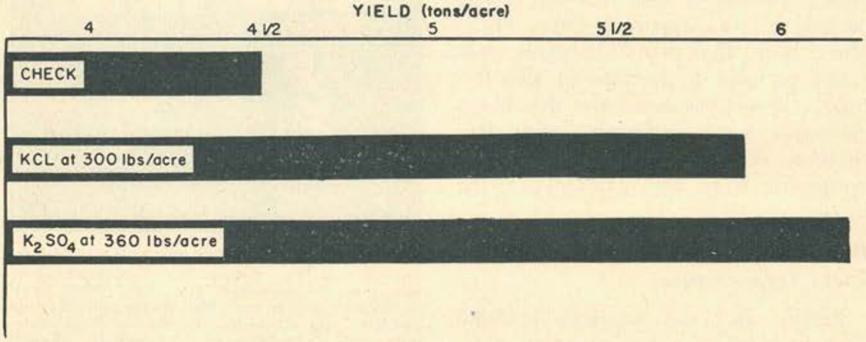


**Fig. 6. Grape yields increased about 1.5 tons per acre by applications of muriate of potash (KCl) or sulfate of potash ($K_2SO_4$) at rates to supply 180 lbs. $K_2O$ per acre.**

Fig. 1. This four-year-old Redcrest peach tree in replant block is receiving one pound of 8-8-8 per year of age in April, plus 1/4 pound sodium nitrate per year of age in May.

# Fruit Fertilization in New Jersey

*By Ernest G. Christ*

Department of Horticulture, Rutgers University, New Brunswick, New Jersey

FRUIT growers and those of us who work with them will agree, I'm sure, that it is not a simple matter to make general recommendations for the fertilization of orchard fruits or small fruits. Recommendations of a general nature are prepared, however, by the Agricultural Experiment Station and Extension Service for the important fruit growing areas in the country. These recommendations do not change appreciably from year to year, or even from decade to decade in many cases. Some new suggestions or recommendations appear regularly as new information becomes available from research. The fruit grower must consider these recommendations in their broadest sense and make adjustments and changes when applying them to his farm.

In New Jersey the suggestions for fertilizing fruit have changed somewhat over the last 10 years. These changes have largely been in the NPK ratios, quantities per acre, and placement. At the present time, the three important fruit fertilizer ratios used are 1-1-1, 1-2-1, and 1-2-2. Most generally used are the mixtures 8-8-8, 5-10-5, and 5-10-10. Sodium nitrate, ammonium nitrate, and ammonium sulfate are used to supplement or replace the NPK in some instances. The amounts per acre applied have increased generally in all fruits during the last decade. There has been a change also in the placement

Fig. 2. The first picking from a four-year-old M. A. Blake tree fertilized with one pound 8-8-8 per year of age in April, plus 1/4 pound sodium nitrate per year of age in May.

of most of the fertilizer to the area under the plant as in the case of apple trees and blueberry bushes, and over the plant row in the case of strawberries as opposed to broadcast applications.

Whenever we talk fertilization to a group of growers or those who service growers, we constantly must keep in mind the many other factors affecting the fruit plant. We must also keep in mind that each grower is thinking of his particular orchard or berry planting, and, therefore, what we say must necessarily be of a general nature and frequently qualified so as to take into account these many other factors. Unless one does consider such factors as general soil fertility and other soil management practices, pest control, varieties, rootstocks, and many others, he can easily be misled in favor of certain fertilizer treatments, or in opposition to the use of fertilizers.

In the New Jersey fertilizer and lime recommendations, the following paragraph precedes the discussion of fruit fertilization:

"No simple rule or formula will completely cover the application of fertilizers to fruits. Proper fertilizer practice will depend upon the fertility level of the soil, other environmental conditions, plant growth, and variety. Fruit quality depends largely on growth of the plant and is so greatly influenced by fertilization that good judgment on the part of the grower always will be of prime importance in applying nutrients."

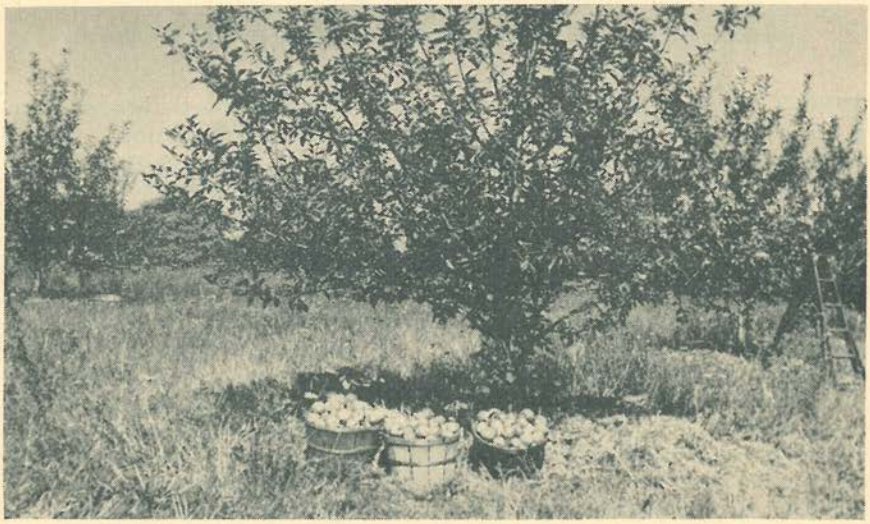

Fig. 3. A five-year-old apple orchard under sod-mulch management. One pound 8-8-8 per year of age applied annually. Three-bushel yield.

In New Jersey there are important peach and apple growing areas on sandy loam soils or silt loams and on stony and shale soils. Some are deep, fertile, and retentive of moisture, and others are shallow and dry. On the sandy soils it is necessary to apply more fertilizer, and supplemental nitrogen is often needed at intervals during the period of rapid growth in the spring. In general, an NPK mixture is preferred over a "nitrogen only" program and this has been a recommendation of long standing. Previous to 1900, studies were begun to determine the nutrient needs of fruit trees including the plum, pear, apple, cherry, and peach. As a result of these early studies, three main conclusions were drawn: (1) Early applications of nitrogen were beneficial in increasing fruit size and total yield; (2) an NPK mixture was required rather than "nitrogen only;" (3) the soil acidity should be maintained at a level no lower than pH 5.5. Many articles have appeared in scientific publications and grower magazines stating the importance of balanced nutrition and verifying these three conclusions. A few of the more recent articles are listed at the end of this paper. All of these stress the importance of balanced orchard fertilization.

As stated previously, the recommendations in this State have changed somewhat in the last 10 years. A 3-12-6 is no longer recommended because there is no evidence for the need of the high phosphorus for fruit trees.

This ratio also is too low in nitrogen in relation to phosphorus for fruit. More and more 8-8-8 and 10-10-10 are being used in apple orchards, and the 5-10-10 is rather standard for peaches, which generally are on more sandy soils. The ratios recommended cannot be correct for all orchards. Adjustments will always be necessary for some orchards. Dr. M. B. Davis of Canada reported that most orchards in Canada receive a 9-5-7 or a 4-8-10. In one long-term orchard fertilizer experiment in New Jersey on a sandy loam soil, a 4-6-8 is being used with good results.

During the past few years, yields and fruit quality in general have been satisfactory and there appears to be no need to make any radical change in the present program. Most growers are now applying the fertilizer under the trees, rather than broadcast in the case of apples. Placing the fertilizer under the

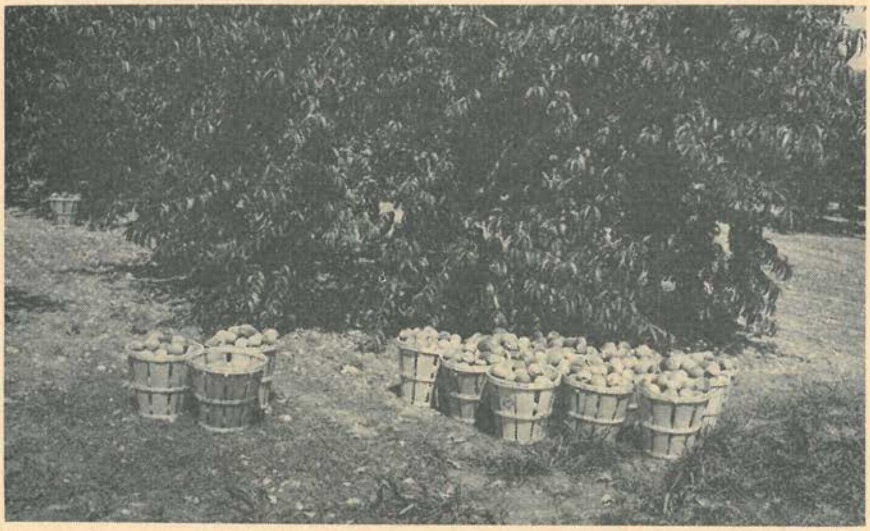

**Fig. 4. Five-year-old Sunhigh peach tree receiving eight pounds of 3-9-12. Twelve baskets first picking from three moderately pruned trees; three bushels first picking from three severely pruned trees. Pruning can nullify a good fertilizer program.**

tree is most efficient, and unless the machinery used will place it under the tree, it must be applied by hand. Some growers place it in a 2- to 3-foot band just inside the limb spread. A few growers use a narrower band. A third method is to cover the area under the tree, beginning about 3 feet from the trunk and extending slightly out beyond the limb spread. The main argument in favor of a narrow band is that the sod cover does not absorb as much of the fertilizer just when the tree needs it most as in the case of a more complete area fertilization. With the area fertilization, more of the feeding roots come in contact with the nutrients, and this may be important. It is difficult to say which method is better. Should we use a narrow band, or should we spread it more generally over the root area? The orchard middle should receive a separate application to encourage good sod and cover crop growth. A different ratio may be needed for the sod or cover crop. With peaches, the broadcast method is quite satisfactory, because the soil area under the tree is pretty much covered, since the trees are planted closer than apples. Growers are quite conscious of the necessity of applying the fertilizer, especially the nitrogen, well ahead of bloom.

### Fall Fertilization

Several of the most successful apple growers apply the fertilizer in the fall during November, or in the winter during December, January, and February. This reduces competition from the sod since it is quite dormant. We have not observed any difficulty with this practice, provided it is done when the trees are dormant and not in early October. A fall or winter application is nothing more than an early spring application in one sense. The value of early fertilization is an established fact and has been observed many times in the increased set of apples on trees that have shown a need for nitrogen the previous season. In a Rome block of 30-year-old trees, which was deficient in nitrogen during June, the grower applied 4 pounds of sodium nitrate per tree in November to one row of 16 trees. An adjacent row received no fall application. Both rows received the annual spring NPK. The following harvest illustrated clearly the value of the fall nitrogen, with an increase of 4 bushels per tree over the check row.

We have tried to impress on the fruit grower that some soils may contain an adequate supply of phosphorus and potassium, following many years of NPK use. A "nitrogen only" fertilization for one or two years can be adequate under these conditions. Several apple growers have followed this practice with success. We caution against the continuance of such a program, however, so as not to induce potassium or other element deficiencies. The soil analysis also may indicate a change to a ratio quite different from one of the three mentioned. One peach grower whose orchard is on a gravelly loam soil is growing excellent fruit, using a 3-9-12 fertilizer. He might be able to grow even better fruit by using a different ratio, but I'm sure it would require several years of careful study to show a distinct improvement.

Now to get down to the general recommendations. For non-bearing apple, peach, plum, and cherry trees, we recommend one pound of 8-8-8 for each year of age of the tree annually applied in the early spring. On many soils, it is necessary to follow this with nitrogen during May or early June at the rate of ⅛ to ¼ pound of sodium nitrate or its equivalent per year of age. This same program can continue during the first few fruit bearing years. Since a full bearing peach tree requires from ½ to 1 pound of actual nitrogen annually, it is recommended that no more than 10 pounds of 5-10-10 be applied to a peach tree as a basic spring application. Also it is recommended that no more than 3 pounds of sodium nitrate, or the equivalent, be applied as a supplement. Both the NPK and the nitrogen may be

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Fig. 1. The row of trees on the left received Mg, Mn, Cu, Zn, and boron in addition to NPK. Trees in the row at the right received only NPK.

# South Carolina's Peach Industry Adopts New Ideas


*By R. J. Ferree*

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THE story of South Carolina's rise to prominence in the production of fresh peaches has been an interesting and varied one. The course of this rise has been marked by milestones of both major and minor importance. Noteworthy in the former are the beginning of commercial peach production in Piedmont South Carolina, the heavy increase in peach tree population in the mid-thirties, the change in fertilizing practices in the late thirties, the introduction of new, earlier, high-colored varieties with chilling requirements adapted to various localities, the introduction and use of the principle of hydrocooling, the introduction and use of organic pesticides, and the use of portable irrigation in peach production. Of slightly lesser importance are the use of minor elements in peach orchards, particularly in central South Carolina, and conservation practices in which permanent or semi-permanent sods are used.

In 1921 and 1922, approximately 11,000 peach trees were planted in Spartanburg county. From this start the plantings increased in this county to the point that there were more than 3 million peach trees in 1948. There was very little increase in both Spartanburg county and the State as a whole from 1922 until 1935. Between 1935 and 1940 the peach tree population increased from slightly more than 1¼ million trees to over 3½ million. About 60% of this increase was in Spartanburg county alone. The peak was reached in 1948 when the peach tree population was approximately 5½ million trees; however, cold injury in three successive years was directly responsible for decreasing this number to approximately 4¾ million.

Up until the late thirties the primary fertilizer recommendation for peaches in South Carolina was the use of nitrogen; however, in the late thirties certain peach plantings indicated by characteristic symptoms, particularly in Piedmont South Carolina, that application of other nutrient elements was necessary. Test work conducted verified this diagnosis. In work conducted by the Clemson College Extension Service, there evolved a new fertilizing program which not only included the use of nitrogen but also adequate amounts of potash and phosphate in conjunction with proper adjustments of soil pH through the use of lime.

The fertilizer recommendations today for South Carolina peach orchards are based on this work as well as on other research done by workers in peach-growing states in the East. On the basis of a 400-bushel annual production per acre, fertilizer recommendations are as follows: 30 to 50 lbs. of N, 100 lbs. $K_2O$, 50 to 60 lbs. of $P_2O_5$. About one half of the potash and all of the phosphate, along with a small portion of the nitrogen, are applied in the fall at the time the cover crop is seeded, and the remainder of the potash and nitrogen is applied prior to February 1. On early varieties, particularly those ripening prior to July 1, a portion of the nitrogen can be applied immediately after harvest, particularly if the trees have a faded, starved appearance. Obviously, this application of nitrogen is intended to assist in proper fruit bud formation.

In 1946 some test work was set up in Chesterfield county on Norfolk sand for the purpose of testing the value of minor elements in peach production. In this test plot, combinations of the following were used: Magnesium, manganese, copper, zinc, and boron. Each plot received a combination of the above minus one, plus N, P, and K with the pH adjusted to 6 through the use of lime containing no magnesium.

Data indicated the best growth to be in the block receiving all the nutrient elements listed; slightly less growth was noted in blocks containing the combinations minus one element. Most noteworthy of the data was the fruit set in 1950. The plot was injured by low temperatures on April 14. The fruit count revealed an average of 130 fruits per tree on the check plot while the plot receiving all of the nutrients showed an average of 220 fruits per tree. As a result of this, a recommendation for the use of minor elements on peaches in the lighter type soil has been made. The recommendation is as follows: 4-8-8, 4-8-12, or 4-12-12 containing 3% MgO, 1% MnO, ½% oxide of copper and 10 lbs. of borax per ton. In addition, trees are to receive one or two spray applications of zinc during the growing season.

The initial planning of the South Carolina peach industry was formed on the basis of a succession of ripening dates using Elberta as the key variety. Specifically, the harvest period for peaches in South Carolina was to follow that of Georgia and before the harvest period of the same variety in the Midwest and Eastern States. Because of this, the Elberta variety and varieties ripening in the same season formed a vast majority of the peaches produced in South Carolina. Up until just before World War II, however, the introduction of new early, highly colored, yellow-fleshed varieties has changed the picture completely. In the twenties and thirties a total of 70% of the peach tree population was planted to the Elberta variety, while as late as 1949, 58% of the trees in the State were Elberta. Since that time these figures have rapidly changed, and now Elberta makes up less than one half of the peach tree population. Of the

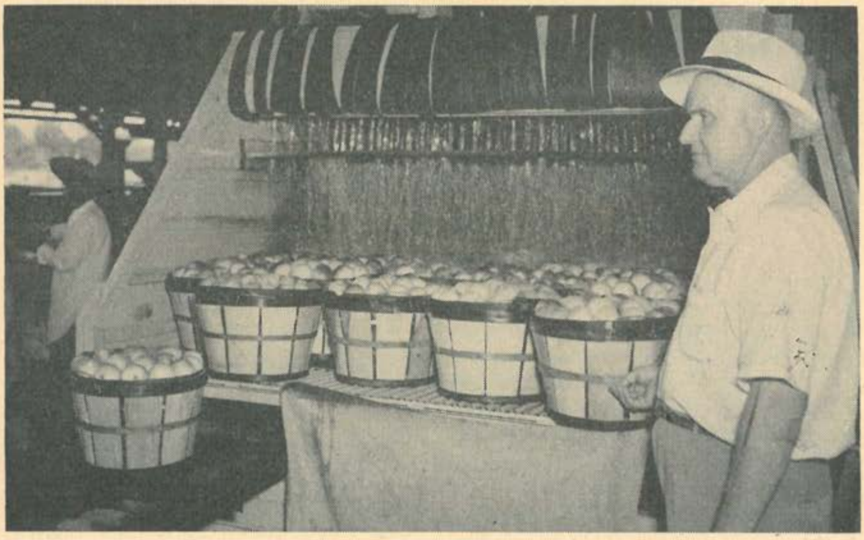

Fig. 2. Hydrocooling Lexington county peaches, Walter P. Rawl, grower.

approximately 250,000 trees being planted during the winter of 1954-55, only about 50,000 are of the Elberta variety, while the remaining 200,000 consist mainly of varieties ripening before Elbertas.

The introduction of these new varieties has influenced marketing, cultural practices, and pest control, and, because of the short chilling requirement of some of the new varieties, a considerable acreage in new areas is being planted to peaches. Heretofore, only sporadic plantings of peaches were made in south-central South Carolina. Most varieties in these plantings had a chilling requirement too long for that latitude; so only partial success, or failure, was the result in about two

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Fig. 3. Portable irrigation in use in a Spartanburg county orchard, Clyde Dobson, grower.

# What Determines Forage Quality?

*By Marshall E. McCullough*

Georgia Agricultural Experiment Station, Experiment, Georgia

IN the past, those concerned with pastures have of necessity thought chiefly of achieving greater production per acre and of extending the grazing period. When the animal men began to use the new plants and better fertilizer and management practices to provide feed for their livestock, it became evident that total forage produced was of limited value in predicting the animal response to a forage program. The next step was an attempt to measure the value of a pound of forage in relation to the animal products it would produce. This was done by measuring the gain in body weight and the milk or other product produced and then calculating the theoretical quantity of nutrients required by the use of some feeding standard. This system was of value in separating valuable from inferior forages, but it did not provide an answer to questions on forage quality necessary to insure a desired level of animal production.

New techniques which permit the measurement of both forage intake and digestibility have paved the way for better descriptions of forage quality. Thus, at present, much emphasis is being placed on what might be termed "qualitative factors" in forage quality. The mere feeding of a certain level of digestible protein and TDN is no assurance of obtaining a desired level of animal production. In this paper, therefore, emphasis will be placed on the factors known to affect the feeding value of a pound of forage.

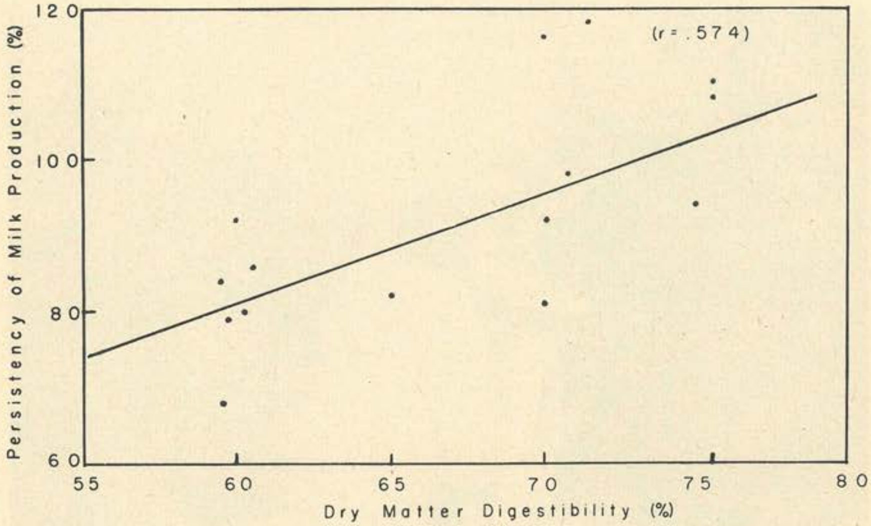


**Fig. 1. The relationship between forage dry matter digestibility and persistency of milk production.**

## Forage Digestibility

The first step in defining forage quality is to obtain a descriptive value for various forage conditions which can be related to the type of animal response obtained. One of the easier and more universally used measures is the percentage of the dry matter that is digested. Such a measure is easily obtained and can be repeated at frequent intervals. It was assumed by many of the earlier workers that digestibility would follow closely the relative stage of maturity of the forage. However, recent studies at several stations have shown that factors other than stage of maturity affect this value. One example of such studies is shown in Table I. The three forages studied (oats, rye, and rescue grass) are common winter forages in Georgia. Obviously, the change in season exerted a greater influence on digestibility than the stage of maturity as measured by the leaf/stem ratio. Also of interest is the difference between species in the degree to which the leaf/stem ratio follows a downward trend in digestibility. Thus rye changed very rapidly while oats changed much more slowly, although the change in digestibility was about the same. Under grazing, the leaf/stem ratio changes several times during the season depending upon grazing pressure, climate, and such fertilizer practices as nitrogen topdressings. Perhaps part of the failure of the digestibility to follow the leaf/stem ratio was due to selective grazing by the experimental animals. Another point that should be mentioned is the possibility that stage of maturity does not have the same meaning in animal nutrition as in agronomy.

While each of these changes may be accompanied by changes in animal performance and forage digestibility, it does not follow that digestibility changes will reflect the true differences in feeding value. In Table II are shown the results from 15 digestibility trials with several forages. Careful study of the table will show something

TABLE I.—CHANGE IN LEAF/STEM RATIO AND DIGESTIBILITY OF THREE WINTER FORAGES.

| Date | Forage | Ratio* | | Dry matter digestibility |
|---|---|---|---|---|
| | | Leaf | Stem | |
| | | % | % | % |
| March 7 | Rescue | 100 | 0 | 80 |
| | Rye | 100 | 0 | 78 |
| | Oats | 100 | 0 | 78 |
| April 3 | Rescue | 55 | 45 | 80 |
| | Rye | 16 | 84 | 73 |
| | Oats | 75 | 25 | 79 |
| April 14 | Rescue | 24 | 76 | 68 |
| | Rye | 13 | 87 | 69 |
| | Oats | 54 | 46 | 71 |

* Dry matter

of the variation in animal response to forages of similar dry matter digestibilities. Three of the observations were made with forage having a dry matter digestibility of 70%. The range in animal response to the forage conditions as measured by persistency of milk production was from 81 to 116%. In Figure 1 the relationship between persistency of milk production and dry matter digestibility for the data in Table II is shown graphically. The correlation of 0.574 indicates a good relationship but leaves little doubt that other factors are involved.

## Balance of the Ration

The effect of ration balance on the efficiency of feed utilization has long been known to workers in animal nutrition. Numerous experiments have shown that each nutrient expresses its maximum value when present in the ration at an optimum level. Unfortunately, in feeds, as in fertilizers, many factors affect the use of any one nutrient and there is no one level that is ideal for all conditions. Thus the ideal level of crude protein depends upon the energy level; the ideal amount of phosphorus depends upon the cal-

TABLE II.—DATA FROM DIGESTIBILITY TRIALS WITH SEVERAL SOUTHERN FORAGES.

| Forage | Persistency of milk production | Therms of metabolizable energy/kg. | Dry matter digestibility | Crude fiber | Digestible protein |
|---|---|---|---|---|---|
| | % | T | % | % | % |
| Starr Millet | 98 | 2.61 | 73 | 21 | 25 |
| B. T. Millet | 92 | 2.43 | 60 | 22 | 17 |
| T. Sudan | 93 | 2.42 | 65 | 23 | 19 |
| Bermuda | 79 | 2.20 | 59 | 27 | 13 |
| Dallis | 68 | 2.07 | 58 | 30 | 15 |
| Starr Millet | 80 | 2.33 | 61 | 26 | 21 |
| Fescue | 84 | 2.31 | 58 | 24 | 11 |
| Fescue | 86 | 2.34 | 62 | 25 | 15 |
| Fescue | 82 | 2.49 | 65 | 22 | 19 |
| B. T. Millet | 92 | 2.53 | 70 | 22 | 17 |
| Fescue | 81 | 2.63 | 70 | 20 | 17 |
| Temporary* | 116 | 2.98 | 70 | 13 | 25 |
| Temporary | 110 | 2.85 | 77 | 16 | 17 |
| Temporary | 108 | 2.62 | 77 | 21 | 14 |
| Temporary | 94 | 2.58 | 75 | 21 | 12 |

* Oats, ryegrass, and crimson clover.

cium and crude fiber level; and the crude fiber level depends upon the composition of the crude fiber. The apparent impossibility of defining a balanced ration does not preclude the possibility of defining limits within which the ration is balanced. In forages nearly all studies have shown a negative relationship between an increase in crude fiber and animal production and a positive relationship with crude protein. Axellson has shown that there is an optimum content of both crude fiber and protein in balanced rations for ruminants.

In Figure 2 the results of Axellson's work relative to the efficiency with which the available energy of a ration is converted to body weight are shown. It shows quite clearly that both a deficiency or an excess of either of the nutrients reduced the efficiency of feed utilization. Reference to the figure will show that in most forages the crude fiber level usually occurs in excess of the optimum while the digestible protein level usually falls below the optimum. Thus some explanation is afforded for the detrimental effect of a crude fiber increase and the beneficial effect of a crude protein increase. (The optimum discussed here should not be confused with feeding standards or minimum nutrient requirements.)

In forages the change in fiber and protein usually occurs concomitantly. Thus Axellson proposed the formula $Y = 3.24 + 0.00140X_1 - 0.0391X_2$ (where $Y$=the m.e. per Kg of dry matter, $X_1$=the amount of digestible protein in grams per Kg of dry matter, and $X_2$ =the content of crude fiber in % of the dry matter) to describe changes in the nutritive value of feeds. In Figure 3 the forages listed in Table II have been calculated using the above formula. The correlation of 0.876 shows one of the best relationships ever reported between a measurable forage condition and animal production. Since fescue does not appear to react as a normal forage, the data have been recalculated omitting the fescue data and the correlation becomes 0.948. Obviously, therefore, two of the more important factors in determining animal response to forage appear to be the content of crude fiber and digestible protein.

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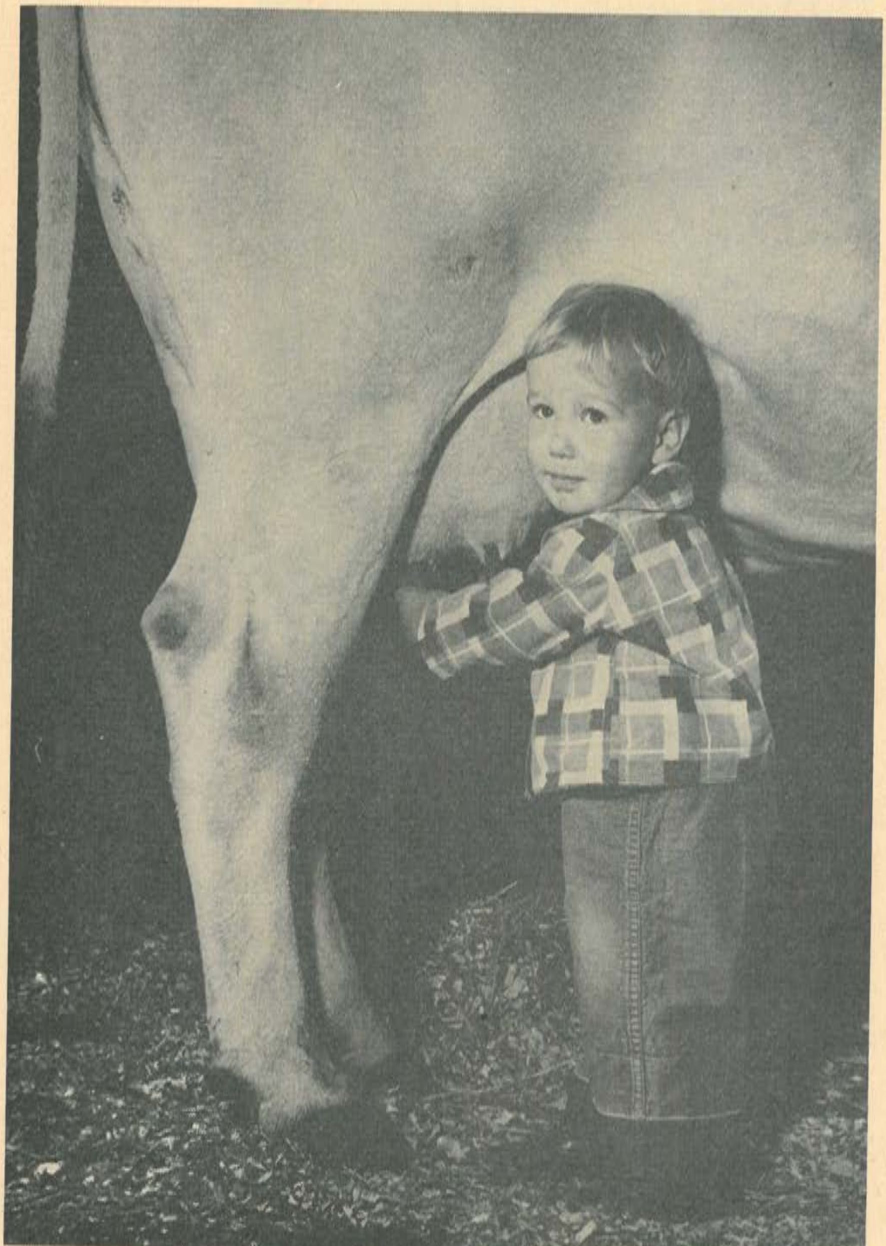
# PICTORIAL



Chore Boy!

**Left: Selling a corn planter at farmer's closing-out sale.**

**Below: Emptying bins of old corn for shipment South by river barge.**

**Above: Bulk spreading of fertilizer has become a year-round job.**

**Right: Unloading sacked fertilizer from freight cars.**

**Winter's Icy Grip!**

# *The Editors Talk*

## Our Cover Picture

The culture of grapes is the largest fruit growing industry in the world. It is an important crop in many countries on six continents. Although the United States produces about 3,000,000 tons of grapes annually, this represents only about one tenth of the world's total tonnage, an indication of the world-wide importance of this fruit.

The grape is one of the oldest of the cultivated fruits. In fact, its culture is so ancient that its place of origin is uncertain. Seeds of the Old World grape, *Vitis vinifera,* have been found in the oldest of the Egyptian tombs, and the evidence indicates that this fruit was cultivated in Egypt at least 6,000 years ago.

On the basis of present knowledge it appears that the Old World or *vinifera* grape may have originated in the region of the Black and Caspian Seas. Varieties of this species now provide the bulk of the world's grape tonnage.

More than 90 per cent of the grape tonnage in the United States is produced from *Vitis vinifera,* mainly in California. *V. vinifera* cannot be grown in areas of more rigorous climate. *Vitis labrusca,* a native American species, is grown in Michigan, New York, Pennsylvania, Ohio, Washington, and other northern States. A large majority of this production is of the Concord variety, with limited production of other varieties, such as Delaware, Niagara, Fredonia, etc.

Until recent years nitrogen carriers were the standard fertilizers used in Michigan vineyards. During the past few years, however, grape growers, in general, have been making annual applications of N-P-K fertilizers in their vineyards. Most of the growers have used mixtures, such as 8-8-8, 10-10-10, or 12-12-12 at rates ranging from 200 to 500 pounds on an acre. These applications, while a step in the right direction, often have not furnished enough potassium for vigorous vine growth and high yields of grapes.

The value of potash as a fertilizer for grapevines has been known for over a quarter of a century in Europe and also for many years in the United States. Workers in France and Germany have reported numerous cases of leaf browning and marginal chlorosis as symptoms of potash deficiency on grapevines. Increased yields of grapes resulting from applications of potash fertilizers have been reported from both of these countries. Reports of potassium deficiency in United States' vineyards have come from most major grape producing States. In most cases, yields of fruit have been increased markedly by additions of potash in areas where potassium deficiency has previously been found.

During the past two years potassium deficiency has been identified in many Michigan vineyards. The lower half of the cover picture shows leaves and fruit clusters from healthy Concord vines. The upper half illustrates varying stages or degrees of potash-hunger symptoms on grape leaves, and also smaller and poorly colored fruits. Marginal scorch and crinkling of the leaves are characteristic of potassium deficiency in the advanced stages. These symptoms are preceded earlier by chlorosis of the leaf margins. Affected leaves are smaller and lighter green in color than healthy leaves. The petioles of such leaves usually have only 0.10 to 0.75 per cent potassium on a dry weight basis. Petioles from normal appearing leaves usually contain more than 0.75 per cent potassium.

The fruit clusters and berries from potassium-deficient vines usually are smaller and mature later than fruit from healthy vines. In severe cases the berries may never ripen and color fully.

Applications of 180 pounds of actual potash ($K_2O$) to an acre resulted not only in an improvement in vine vigor but also in larger yields of fruit in Michigan vineyards which were deficient in available potassium.

For a complete story on these experiments turn to article, "Shortages of Potash Limit Michigan Grape Yields," beginning on page 13 of this issue.

## Southern Agriculturists Review Their Problems

Research and the dissemination of the findings of research work are important factors in the consideration of a potential. Therefore it was not surprising that the 52nd annual convention of the Association of Southern Agricultural Workers with its theme of "The South's Agricultural Potentials" drew more than 1,000 research workers, instructors, and extension people to Louisville, Kentucky, February 7-9.

It is significant to note that the Association was founded in 1899 as the Cotton States Association of the Commissioners of Agriculture with the aim of improving and promoting "the agricultural interests of the cotton states." While cotton is still the major cash crop of the South, the sessions of this convention which were devoted to animal production, forestry, horticulture, poultry, etc. evidenced the progress toward diversification that has been made. Specifically, interest of the big assemblage was sectionalized as follows: agricultural economics and rural sociology; agricultural editors; agricultural engineers; agronomy; animal production; dairy science; forestry; home economics; horticultural science; marketing; phytopathology; plant physiology; poultry; and soil conservation.

In the agronomy sessions, considerable attention was given to minor elements, the increasing use of nitrogenous fertilizers, and the importance of balanced fertilizers if a maximum of efficiency in crop production is to be obtained. With irrigation a matter of increasing concern in the South, the conservation of water in both soil and plant was highly stressed.

Marketing sessions drew large attendances. One of the big questions upon which more light is sought is "What happens to the consumer's dollar and why is the farmer's share of it shrinking?" A partial explanation was offered in the fact that the consumer seems to be demanding more and more "built-in maid service" with his produce. Figures were presented to show that a homemaker who prepares three meals a day for her family and does all of the work herself can do the job for \$4.90 but it takes her 5½ hours. If she uses partly prepared foods, she can do the cooking in 3.1 hours, but it costs her \$5.80 a day. If she uses ready-to-serve foods, she can put the meals on the table in just 1.6 hours, but the cost goes up to \$6.70 per day. This demand on the part of the consumer for more and more service with what he buys accounts for more and more of his dollar going to the processor and less and less to the farmer.

The new president of the Association is H. C. Sanders, Director, Agricultural Extension Service, Louisiana State University. Elected to the Vice-presidency was W. M. Fifield, Director of Florida Agricultural Experiment Station. B. B. Jones of the Agricultural Extension Service, New Orleans, was elected Secretary-Treasurer, and C. E. Kemmerly, Louisiana Extension Service, Assistant Secretary.

## Season Average Prices Received by Farmers for Specified Commodities *

| Crop Year | Cotton Cents per lb. Aug.-July | Tobacco Cents per lb. ..... | Potatoes Cents per bu. July-June | Sweet Potatoes Cents per bu. July-June | Corn Cents per bu. Oct.-Sept. | Wheat Cents per bu. July-June | Hay[1] Dollars per ton July-June | Cottonseed Dollars per ton July-June | Truck Crops .... |
|---|---|---|---|---|---|---|---|---|---|
| Av. Aug. 1909–July 1914.... | 12.4 | 10.0 | 69.7 | 87.8 | 64.2 | 88.4 | 11.87 | 22.55 | .... |
| 1928........... | 18.0 | 20.0 | 53.2 | 118.0 | 84.0 | 99.8 | 11.22 | 34.17 | .... |
| 1929........... | 16.8 | 18.3 | 131.6 | 117.1 | 79.9 | 103.6 | 10.90 | 30.92 | .... |
| 1930........... | 9.5 | 12.8 | 91.2 | 108.1 | 59.8 | 67.1 | 11.06 | 22.04 | .... |
| 1931........... | 5.7 | 8.2 | 46.0 | 72.6 | 32.0 | 39.0 | 8.69 | 8.97 | .... |
| 1932........... | 6.5 | 10.5 | 38.0 | 54.2 | 31.9 | 38.2 | 6.20 | 10.33 | .... |
| 1933........... | 10.2 | 13.0 | 82.4 | 69.4 | 52.2 | 74.4 | 8.09 | 12.88 | .... |
| 1934........... | 12.4 | 21.3 | 44.6 | 79.8 | 81.5 | 84.8 | 13.20 | 33.00 | .... |
| 1935........... | 11.1 | 18.4 | 59.3 | 70.3 | 65.5 | 83.2 | 7.52 | 30.54 | .... |
| 1936........... | 12.4 | 23.6 | 114.2 | 92.9 | 104.4 | 102.5 | 11.20 | 33.36 | .... |
| 1937........... | 8.4 | 20.4 | 52.9 | 78.0 | 51.8 | 96.2 | 8.74 | 19.51 | .... |
| 1938........... | 8.6 | 19.6 | 55.7 | 69.8 | 48.6 | 56.2 | 6.78 | 21.79 | .... |
| 1939........... | 9.1 | 15.4 | 69.7 | 73.4 | 56.8 | 69.1 | 7.94 | 21.17 | .... |
| 1940........... | 9.9 | 16.0 | 54.1 | 85.4 | 61.8 | 68.2 | 7.59 | 21.73 | .... |
| 1941........... | 17.0 | 26.4 | 80.8 | 92.2 | 75.1 | 94.4 | 9.70 | 47.65 | .... |
| 1942........... | 19.0 | 36.9 | 117.0 | 118.0 | 91.7 | 110.0 | 10.80 | 45.61 | .... |
| 1943........... | 19.9 | 40.5 | 131.0 | 206.0 | 112.0 | 136.0 | 14.80 | 52.10 | .... |
| 1944........... | 20.7 | 42.0 | 150.0 | 190.0 | 109.0 | 141.0 | 16.50 | 52.70 | .... |
| 1945........... | 22.5 | 36.6 | 143.0 | 204.0 | 127.0 | 150.0 | 15.10 | 51.10 | .... |
| 1946........... | 32.6 | 38.2 | 124.0 | 218.0 | 156.0 | 191.0 | 16.70 | 72.00 | .... |
| 1947........... | 31.9 | 38.0 | 162.0 | 217.0 | 216.0 | 229.0 | 17.60 | 85.90 | .... |
| 1948........... | 30.4 | 48.2 | 155.0 | 222.0 | 129.0 | 200.0 | 18.45 | 67.20 | .... |
| 1949........... | 28.6 | 45.9 | 128.0 | 214.0 | 124.0 | 188.0 | 16.50 | 43.40 | .... |
| 1950........... | 40.1 | 51.7 | 91.7 | 173.0 | 153.0 | 200.0 | 16.70 | 86.50 | .... |
| 1951........... | 37.9 | 51.1 | 163.0 | 304.0 | 166.0 | 211.0 | 19.50 | 69.30 | .... |
| 1952 .......... | 34.6 | 49.9 | 198.0 | 338.0 | 153.0 | 209.0 | 19.95 | 69.60 | .... |
| 1953 .......... | 32.3 | 52.2 | 79.7 | 251.0 | 148.0 | 204.0 | 17.45 | 52.60 | |
| 1954 | | | | | | | | | |
| February..... | 30.42 | 31.9 | 65.3 | 258.0 | 143.0 | 206.0 | 18.95 | 51.40 | .... |
| March....... | 31.05 | 27.3 | 53.2 | 252.0 | 144.0 | 209.0 | 18.35 | 50.50 | .... |
| April........ | 31.57 | .... | 70.2 | 268.0 | 145.0 | 206.0 | 18.05 | 50.80 | .... |
| May......... | 32.17 | 58.0 | 134.0 | 263.0 | 147.0 | 200.0 | 17.05 | 51.40 | .... |
| June........ | 32.31 | 53.0 | 151.0 | 270.0 | 149.0 | 191.0 | 15.65 | 51.40 | .... |
| July......... | 32.18 | 52.7 | 149.0 | 302.0 | 150.0 | 200.0 | 15.15 | 54.00 | .... |
| August...... | 34.00 | 48.2 | 141.0 | 259.0 | 153.0 | 203.0 | 16.45 | 61.30 | .... |
| September... | 34.55 | 53.0 | 116.0 | 236.0 | 153.0 | 207.0 | 17.25 | 61.60 | .... |
| October...... | 34.67 | 53.6 | 93.2 | 212.0 | 145.0 | 208.0 | 17.55 | 60.20 | .... |
| November... | 33.17 | 52.0 | 109.0 | 216.0 | 137.0 | 212.0 | 18.15 | 59.40 | .... |
| December.... | 32.67 | 50.0 | 105.0 | 254.0 | 139.0 | 212.0 | 18.55 | 59.60 | .... |
| January...... | 32.51 | 42.4 | 113.0 | 283.0 | 140.0 | 214.0 | 18.75 | 56.80 | .... |

**Index Numbers (Aug. 1909—July 1914 = 100)**

| Crop Year | Cotton | Tobacco | Potatoes | Sweet Potatoes | Corn | Wheat | Hay | Cottonseed | Truck Crops |
|---|---|---|---|---|---|---|---|---|---|
| 1928........... | 145 | 200 | 76 | 134 | 131 | 113 | 95 | 152 | 147 |
| 1929........... | 135 | 183 | 189 | 133 | 124 | 117 | 92 | 137 | 137 |
| 1930........... | 77 | 128 | 131 | 123 | 93 | 76 | 93 | 98 | 128 |
| 1931........... | 46 | 82 | 66 | 83 | 50 | 44 | 73 | 40 | 107 |
| 1932........... | 52 | 105 | 55 | 62 | 50 | 43 | 52 | 46 | 100 |
| 1933........... | 82 | 130 | 118 | 79 | 81 | 84 | 68 | 57 | 90 |
| 1934........... | 100 | 213 | 64 | 91 | 127 | 96 | 111 | 146 | 94 |
| 1935........... | 90 | 184 | 85 | 80 | 102 | 94 | 63 | 135 | 116 |
| 1936........... | 100 | 236 | 164 | 106 | 163 | 116 | 94 | 148 | 108 |
| 1937........... | 68 | 204 | 76 | 89 | 81 | 109 | 74 | 87 | 114 |
| 1938........... | 69 | 196 | 80 | 79 | 76 | 64 | 57 | 97 | 96 |
| 1939........... | 73 | 154 | 100 | 84 | 88 | 78 | 67 | 94 | 98 |
| 1940........... | 80 | 160 | 78 | 97 | 96 | 77 | 64 | 96 | 122 |
| 1941........... | 137 | 264 | 116 | 105 | 117 | 107 | 82 | 211 | 138 |
| 1942........... | 153 | 369 | 168 | 134 | 143 | 124 | 91 | 202 | 178 |
| 1943........... | 160 | 405 | 188 | 235 | 174 | 154 | 125 | 231 | 270 |
| 1944........... | 167 | 420 | 214 | 216 | 170 | 160 | 139 | 234 | 236 |
| 1945........... | 181 | 366 | 205 | 232 | 198 | 170 | 127 | 227 | 240 |
| 1946........... | 263 | 382 | 178 | 248 | 212 | 209 | 141 | 319 | 217 |
| 1947........... | 257 | 380 | 232 | 248 | 336 | 259 | 148 | 381 | 262 |
| 1948........... | 245 | 482 | 222 | 253 | 201 | 226 | 155 | 298 | 253 |
| 1949........... | 231 | 459 | 184 | 244 | 193 | 213 | 139 | 192 | 232 |
| 1950........... | 323 | 517 | 132 | 197 | 238 | 226 | 141 | 384 | 211 |
| 1951........... | 306 | 512 | 233 | 346 | 259 | 239 | 164 | 307 | 269 |
| 1952........... | 279 | 499 | 284 | 385 | 238 | 236 | 168 | 309 | 274 |
| 1953........... | 260 | 522 | 114 | 286 | 231 | 231 | 147 | 233 | 240 |
| 1954 | | | | | | | | | |
| February.... | 245 | 319 | 94 | 294 | 223 | 233 | 160 | 228 | 233 |
| March....... | 250 | 273 | 76 | 287 | 224 | 236 | 155 | 224 | 246 |
| April........ | 255 | ... | 101 | 305 | 226 | 233 | 152 | 225 | 225 |
| May........ | 259 | 580 | 192 | 300 | 229 | 226 | 144 | 228 | 279 |
| June........ | 261 | 530 | 217 | 308 | 232 | 216 | 132 | 228 | 200 |
| July........ | 260 | 527 | 214 | 344 | 234 | 226 | 128 | 239 | 243 |
| August ..... | 274 | 482 | 202 | 295 | 238 | 230 | 139 | 272 | 223 |
| September... | 279 | 530 | 166 | 269 | 238 | 234 | 145 | 273 | 170 |
| October...... | 280 | 536 | 134 | 241 | 226 | 235 | 148 | 267 | 191 |
| November... | 268 | 520 | 156 | 246 | 213 | 240 | 153 | 263 | 237 |
| December.... | 263 | 500 | 151 | 289 | 217 | 240 | 156 | 264 | 216 |
| January...... | 262 | 424 | 162 | 322 | 218 | 242 | 158 | 252 | 263 |

## Wholesale Prices of Phosphates and Potash **

| | Superphosphate, Baltimore, per unit | Florida land pebble, 68% f.o.b. mines, bulk, per ton | Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton | Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2] | Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2] | Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2] | Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2] |
|---|---|---|---|---|---|---|---|
| 1910-14 | $0.536 | $3.61 | $4.88 | $0.714 | $0.953 | $24.18 | $0.657 |
| 1928 | .580 | 3.12 | 5.50 | .669 | .957 | 26.46 | .607 |
| 1929 | .609 | 3.18 | 5.50 | .672 | .962 | 26.59 | .610 |
| 1930 | .542 | 3.18 | 5.50 | .681 | .973 | 26.92 | .618 |
| 1931 | .485 | 3.18 | 5.50 | .681 | .973 | 26.92 | .618 |
| 1932 | .458 | 3.18 | 5.50 | .681 | .963 | 26.90 | .618 |
| 1933 | .434 | 3.11 | 5.50 | .662 | .864 | 25.10 | .601 |
| 1934 | .487 | 3.14 | 5.67 | .486 | .751 | 22.49 | .483 |
| 1935 | .492 | 3.30 | 5.69 | .415 | .684 | 21.44 | .444 |
| 1936 | .476 | 1.85 | 5.50 | .464 | .708 | 22.94 | .505 |
| 1937 | .510 | 1.85 | 5.50 | .508 | .757 | 24.70 | .556 |
| 1938 | .492 | 1.85 | 5.50 | .523 | .774 | 15.17 | .572 |
| 1939 | .478 | 1.90 | 5.50 | .521 | .751 | 24.52 | .570 |
| 1940 | .516 | 1.90 | 5.50 | .517 | .730 | 24.75 | .573 |
| 1941 | .547 | 1.94 | 5.64 | .522 | .780 | 25.55 | .367 |
| 1942 | .600 | 2.13 | 6.29 | .522 | .810 | 25.74 | .205 |
| 1943 | .631 | 2.00 | 5.93 | .522 | .786 | 25.35 | .195 |
| 1944 | .645 | 2.10 | 6.10 | .522 | .777 | 25.35 | .195 |
| 1945 | .650 | 2.20 | 6.23 | .522 | .777 | 25.35 | .195 |
| 1946 | .671 | 2.41 | 6.50 | .508 | .769 | 24.70 | .190 |
| 1947 | .746 | 3.05 | 6.60 | .432 | .706 | 18.93 | .195 |
| 1948 | .764 | 4.27 | 6.60 | .397 | .681 | 14.14 | .195 |
| 1949 | .770 | 3.88 | 6.22 | .397 | .703 | 14.14 | .195 |
| 1950 | .763 | 3.83 | 5.47 | .371 | .716 | 14.33 | .195 |
| 1951 | .813 | 3.98 | 5.47 | .401 | .780 | 15.25 | .200 |
| 1952 | .849 | 3.98 | 5.47 | .401 | .793 | 15.25 | .200 |
| 1953 | .878 | .... | .... | .... | .793 | 15.25 | .200 |
| 1954 | | | | | | | |
| February | .895 | .... | .... | .430 | .827 | 16.00 | .210 |
| March | .895 | .... | .... | .430 | .827 | 16.00 | .210 |
| April | .895 | .... | .... | .430 | .827 | 16.00 | .210 |
| May | .895 | .... | .... | .430 | .827 | 16.00 | .210 |
| June | .895 | .... | .... | .359 | .710 | 13.45 | .174 |
| July | .895 | .... | .... | .388 | .765 | 14.75 | .184 |
| August | .895 | .... | .... | .388 | .765 | 14.75 | .184 |
| September | .895 | .... | .... | .388 | .765 | 14.75 | .184 |
| October | .895 | .... | .... | .388 | .765 | 14.75 | .184 |
| November | .895 | .... | .... | .388 | .765 | 14.75 | .184 |
| December | .895 | .... | .... | .405 | .825 | 16.00 | .193 |
| January | .895 | .... | .... | .405 | .825 | 16.00 | .193 |

### Index Numbers (1910-14 = 100)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1928 | 108 | 86 | 113 | 94 | 100 | 109 | 92 |
| 1929 | 114 | 88 | 113 | 94 | 101 | 110 | 93 |
| 1930 | 101 | 88 | 113 | 95 | 102 | 111 | 94 |
| 1931 | 90 | 88 | 113 | 95 | 102 | 111 | 94 |
| 1932 | 85 | 88 | 113 | 95 | 101 | 111 | 94 |
| 1933 | 81 | 86 | 113 | 93 | 91 | 104 | 91 |
| 1934 | 91 | 87 | 110 | 68 | 79 | 93 | 74 |
| 1935 | 92 | 91 | 117 | 58 | 72 | 89 | 68 |
| 1936 | 89 | 51 | 113 | 65 | 74 | 95 | 77 |
| 1937 | 95 | 51 | 113 | 71 | 79 | 102 | 85 |
| 1938 | 92 | 51 | 113 | 73 | 81 | 104 | 87 |
| 1939 | 89 | 53 | 113 | 73 | 79 | 101 | 87 |
| 1940 | 96 | 53 | 113 | 72 | 77 | 102 | 87 |
| 1941 | 102 | 54 | 110 | 73 | 82 | 106 | 87 |
| 1942 | 112 | 59 | 129 | 73 | 85 | 106 | 84 |
| 1943 | 117 | 55 | 121 | 73 | 82 | 105 | 83 |
| 1944 | 120 | 58 | 125 | 73 | 82 | 105 | 83 |
| 1945 | 121 | 61 | 128 | 73 | 82 | 105 | 83 |
| 1946 | 125 | 67 | 133 | 71 | 81 | 102 | 82 |
| 1947 | 139 | 84 | 135 | 70 | 74 | 78 | 83 |
| 1948 | 143 | 118 | 135 | 67 | 72 | 58 | 83 |
| 1949 | 144 | 108 | 128 | 67 | 74 | 58 | 83 |
| 1950 | 142 | 106 | 112 | 68 | 75 | 59 | 83 |
| 1951 | 152 | 110 | 112 | 72 | 82 | 63 | 83 |
| 1952 | 158 | 110 | 112 | 72 | 83 | 63 | 83 |
| 1953 | 164 | ... | ... | 73 | 83 | 63 | 83 |
| 1954 | | | | | | | |
| February | 167 | ... | ... | 76 | 87 | 66 | 85 |
| March | 167 | ... | ... | 76 | 87 | 66 | 85 |
| April | 167 | ... | ... | 76 | 87 | 66 | 85 |
| May | 167 | ... | ... | 76 | 87 | 66 | 85 |
| June | 167 | ... | ... | 66 | 75 | 56 | 79 |
| July | 167 | ... | ... | 70 | 80 | 61 | 81 |
| August | 167 | ... | ... | 70 | 80 | 61 | 81 |
| September | 167 | ... | ... | 70 | 80 | 61 | 81 |
| October | 167 | ... | ... | 70 | 80 | 61 | 81 |
| November | 167 | ... | ... | 70 | 80 | 61 | 81 |
| December | 167 | ... | ... | 72 | 87 | 66 | 83 |
| January | 167 | ... | ... | 72 | 87 | 66 | 83 |

## Wholesale Prices of Ammoniates **

| | Nitrate of soda bulk per unit N | Sulphate of ammonia bulk per unit N | Cottonseed meal S. E. Mills per unit N | Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N | Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N | High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N |
|---|---|---|---|---|---|---|
| 1910–14 | $2.68 | $2.85 | $3.50 | $3.53 | $3.37 | $3.52 |
| 1928 | 2.67 | 2.30 | 7.06 | 6.63 | 4.92 | 6.00 |
| 1929 | 2.57 | 2.04 | 5.64 | 5.00 | 4.61 | 5.72 |
| 1930 | 2.47 | 1.81 | 4.78 | 4.96 | 3.79 | 4.58 |
| 1931 | 2.34 | 1.46 | 3.10 | 3.95 | 2.11 | 2.46 |
| 1932 | 1.87 | 1.04 | 2.18 | 2.18 | 1.21 | 1.36 |
| 1933 | 1.52 | 1.12 | 2.95 | 2.86 | 2.06 | 2.46 |
| 1934 | 1.52 | 1.20 | 4.46 | 3.15 | 2.67 | 3.27 |
| 1935 | 1.47 | 1.15 | 4.59 | 3.10 | 3.06 | 3.65 |
| 1936 | 1.53 | 1.23 | 4.17 | 3.42 | 3.58 | 4.25 |
| 1937 | 1.63 | 1.32 | 4.91 | 4.66 | 4.04 | 4.80 |
| 1938 | 1.69 | 1.38 | 3.69 | 3.76 | 3.15 | 3.53 |
| 1939 | 1.69 | 1.35 | 4.02 | 4.41 | 3.87 | 3.90 |
| 1940 | 1.69 | 1.36 | 4.64 | 4.36 | 3.33 | 3.39 |
| 1941 | 1.69 | 1.41 | 5.50 | 5.32 | 3.76 | 4.43 |
| 1942 | 1.74 | 1.41 | 6.11 | 5.77 | 5.04 | 6.76 |
| 1943 | 1.75 | 1.42 | 6.30 | 5.77 | 4.86 | 6.62 |
| 1944 | 1.75 | 1.42 | 7.68 | 5.77 | 4.86 | 6.71 |
| 1945 | 1.75 | 1.42 | 7.81 | 5.77 | 4.86 | 6.71 |
| 1946 | 1.97 | 1.44 | 11.04 | 7.38 | 6.60 | 9.33 |
| 1947 | 2.50 | 1.60 | 12.72 | 10.66 | 12.63 | 10.46 |
| 1948 | 2.86 | 2.03 | 12.94 | 10.59 | 10.84 | 9.85 |
| 1949 | 3.15 | 2.29 | 10.11 | 13.18 | 10.73 | 10.62 |
| 1950 | 3.00 | 1.95 | 11.01 | 11.70 | 10.21 | 9.36 |
| 1951 | 3.16 | 1.97 | 13.20 | 10.92 | 10.18 | 10.09 |
| 1952 | 3.34 | 2.09 | 13.95 | 11.27 | 9.72 | 9.16 |
| 1953 | 3.26 | 2.27 | 11.04 | 11.19 | 7.39 | 7.09 |
| 1954 | | | | | | |
| February | 3.09 | 2.22 | 11.20 | 11.45 | 9.34 | 10.02 |
| March | 3.09 | 2.22 | 11.35 | 11.70 | 9.59 | 10.20 |
| April | 3.09 | 2.22 | 11.63 | 12.15 | 10.32 | 10.55 |
| May | 3.09 | 2.22 | 11.40 | 12.15 | 11.47 | 10.74 |
| June | 3.09 | 2.18 | 10.76 | 12.15 | 10.09 | 9.87 |
| July | 3.09 | 2.18 | 11.12 | 11.28 | 10.02 | 9.87 |
| August | 3.09 | 2.18 | 12.37 | 11.19 | 9.83 | 11.19 |
| September | 3.09 | 2.18 | 11.51 | 10.85 | 9.78 | 10.09 |
| October | 3.01 | 2.18 | 11.55 | 11.26 | 9.64 | 9.94 |
| November | 2.98 | 2.18 | 11.85 | 11.78 | 8.80 | 9.23 |
| December | 2.98 | 2.18 | 11.98 | 12.41 | 8.50 | 8.35 |
| January | 2.98 | 2.18 | 12.00 | 12.35 | 8.32 | 8.32 |

### Index Numbers (1910-14 = 100)

| | Nitrate of soda | Sulphate of ammonia | Cottonseed meal | Fish scrap | Tankage | High grade ground blood |
|---|---|---|---|---|---|---|
| 1928 | 100 | 81 | 202 | 188 | 146 | 170 |
| 1929 | 96 | 72 | 161 | 142 | 137 | 162 |
| 1930 | 92 | 64 | 137 | 141 | 112 | 130 |
| 1931 | 88 | 51 | 89 | 112 | 63 | 70 |
| 1932 | 71 | 36 | 62 | 62 | 36 | 39 |
| 1933 | 59 | 39 | 84 | 81 | 97 | 71 |
| 1934 | 59 | 42 | 127 | 89 | 79 | 93 |
| 1935 | 57 | 40 | 131 | 88 | 91 | 104 |
| 1936 | 59 | 43 | 119 | 97 | 106 | 131 |
| 1937 | 61 | 46 | 140 | 132 | 120 | 122 |
| 1938 | 63 | 48 | 105 | 106 | 93 | 100 |
| 1939 | 63 | 47 | 115 | 125 | 115 | 111 |
| 1940 | 63 | 48 | 133 | 124 | 99 | 96 |
| 1941 | 63 | 49 | 157 | 151 | 112 | 126 |
| 1942 | 65 | 49 | 175 | 163 | 150 | 192 |
| 1943 | 65 | 50 | 180 | 163 | 144 | 189 |
| 1944 | 65 | 50 | 219 | 163 | 144 | 191 |
| 1945 | 65 | 50 | 223 | 163 | 144 | 191 |
| 1946 | 74 | 51 | 315 | 209 | 196 | 265 |
| 1947 | 93 | 56 | 363 | 302 | 374 | 297 |
| 1948 | 107 | 71 | 370 | 300 | 322 | 280 |
| 1949 | 117 | 80 | 289 | 373 | 318 | 302 |
| 1950 | 112 | 68 | 315 | 331 | 303 | 266 |
| 1951 | 118 | 69 | 377 | 310 | 302 | 287 |
| 1952 | 125 | 74 | 399 | 319 | 288 | 260 |
| 1953 | 122 | 80 | 315 | 317 | 219 | 201 |
| 1954 | | | | | | |
| February | 115 | 78 | 320 | 324 | 277 | 285 |
| March | 115 | 78 | 324 | 331 | 285 | 290 |
| April | 115 | 78 | 332 | 344 | 306 | 300 |
| May | 115 | 78 | 326 | 344 | 340 | 305 |
| June | 115 | 76 | 307 | 344 | 299 | 280 |
| July | 115 | 76 | 318 | 320 | 297 | 280 |
| August | 115 | 76 | 353 | 317 | 292 | 317 |
| September | 115 | 76 | 329 | 307 | 290 | 287 |
| October | 112 | 76 | 330 | 319 | 286 | 282 |
| November | 111 | 76 | 339 | 334 | 261 | 262 |
| December | 111 | 76 | 342 | 352 | 252 | 237 |
| January | 111 | 76 | 343 | 350 | 247 | 236 |

## Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

| | Farm prices* | Prices paid by farmers for commodities bought* | Wholesale prices of all commodities† | Fertilizer material‡ | Chemical ammoniates | Organic ammoniates | Superphosphate | Potash** |
|---|---|---|---|---|---|---|---|---|
| 1928 | 148 | 152 | 141 | 121 | 87 | 177 | 108 | 97 |
| 1929 | 148 | 150 | 139 | 114 | 79 | 146 | 114 | 97 |
| 1930 | 125 | 140 | 126 | 105 | 72 | 131 | 101 | 99 |
| 1931 | 87 | 119 | 107 | 83 | 62 | 83 | 90 | 99 |
| 1932 | 65 | 102 | 95 | 71 | 46 | 48 | 85 | 99 |
| 1933 | 70 | 104 | 96 | 70 | 45 | 71 | 81 | 95 |
| 1934 | 90 | 118 | 109 | 72 | 47 | 90 | 91 | 72 |
| 1935 | 109 | 123 | 117 | 70 | 45 | 97 | 92 | 63 |
| 1936 | 114 | 123 | 118 | 73 | 47 | 107 | 89 | 69 |
| 1937 | 122 | 130 | 126 | 81 | 50 | 129 | 95 | 75 |
| 1938 | 97 | 122 | 115 | 78 | 52 | 101 | 92 | 77 |
| 1939 | 95 | 121 | 112 | 79 | 51 | 119 | 89 | 77 |
| 1940 | 100 | 122 | 115 | 80 | 52 | 114 | 96 | 77 |
| 1941 | 124 | 130 | 127 | 86 | 56 | 130 | 102 | 77 |
| 1942 | 159 | 149 | 144 | 93 | 57 | 161 | 112 | 77 |
| 1943 | 193 | 165 | 151 | 94 | 57 | 160 | 117 | 77 |
| 1944 | 197 | 174 | 152 | 96 | 57 | 174 | 120 | 76 |
| 1945 | 207 | 180 | 154 | 97 | 57 | 175 | 121 | 76 |
| 1946 | 236 | 197 | 177 | 107 | 62 | 240 | 125 | 75 |
| 1947 | 276 | 231 | 222 | 130 | 74 | 362 | 139 | 72 |
| 1948 | 287 | 250 | 241 | 134 | 89 | 314 | 143 | 70 |
| 1949 | 250 | 240 | 226 | 137 | 99 | 319 | 144 | 70 |
| 1950 | 258 | 246 | 232 | 132 | 89 | 314 | 142 | 72 |
| 1951 | 302 | 271 | 258 | 139 | 93 | 331 | 152 | 76 |
| 1952 | 288 | 273 | 251 | 144 | 98 | 333 | 158 | 76 |
| 1953 | 258 | 262 | 247 | 139 | 100 | 269 | 164 | 77 |
| 1954 | | | | | | | | |
| February | 258 | 264 | 248 | 142 | 96 | 301 | 167 | 80 |
| March | 256 | 264 | 250 | 143 | 96 | 307 | 167 | 80 |
| April | 257 | 265 | 250 | 145 | 96 | 323 | 167 | 80 |
| May | 258 | 267 | 250 | 147 | 96 | 338 | 167 | 80 |
| June | 248 | 265 | 248 | 141 | 95 | 311 | 167 | 69 |
| July | 247 | 263 | 248 | 142 | 95 | 310 | 167 | 74 |
| August | 251 | 264 | 248 | 143 | 95 | 319 | 167 | 74 |
| September | 246 | 263 | 248 | 142 | 95 | 308 | 167 | 74 |
| October | 242 | 262 | 248 | 141 | 94 | 308 | 167 | 74 |
| November | 244 | 262 | 248 | 140 | 93 | 301 | 167 | 74 |
| December | 239 | 261 | 245 | 140 | 93 | 300 | 167 | 77 |
| January | 244 | 264 | 248 | 140 | 93 | 297 | 167 | 77 |

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

**[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

**[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.**

**** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

# REVIEWS

**This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.**

## Fertilizers

*"Handbook of Commercial Fertilizers and Soil Amendments," Agr. Exp. Sta., Colo. A. & M. College, Fort Collins, Colo., Bul. 393-A, June 1954, R. S. Whitney and R. H. Tucker.*

*"Quarterly Bulletin, State Board of Agriculture, Containing the Fertilizer, Feed, Lime, and Seed Report of the State Laboratory, January-June—1954," The Green, Dover, Del., Vol. 44, No. 2, June 30, 1954.*

*"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 404, May 1954.*

*"Fertilizer Ratios and Grades Recommended By Delaware, Maryland, and Pennsylvania, Effective January 1, 1955," Agr. Exp. Sta., Univ. of Md., College Park, Md.*

*"Guide to Fertilizer Use in Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 277, Dec. 1954.*

*"Fertilizer Inspection and Analysis 1953, Including Fertilizer Tonnage Data," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., J. H. Longwell, R. C. Prewitt, C. W. Gehrke, and E. W. Cowan.*

*"Commercial Fertilizer Results With Oats, Barley, and Spring Wheat, 1954," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 40, Oct. 1954, G. W. Lowrey, R. A. Olson, A. F. Dreier, and P. L. Ehlers.*

*"North Carolina Fertilizer Report For 1953-1954," State Dept. of Agr., Raleigh, N. C., No. 138, Dec. 1954.*

*"Distribution of Fertilizer in Oklahoma Counties by Grades and Material, For the Period, First Quarter, July 1, 1954 to October 1, 1954," State Dept. of Agr., Oklahoma City, Okla.*

*"Field Crop Recommendations and Rotation Fertilization for Pennsylvania," Agr. Ext. Serv., Pa. State Univ., State College, Pa., Spec. Fldr., Jan. 1955.*

*"For Top Pastures—Top-Dress," Agr. Ext. Serv., Virginia Polytechnic Institute, Blacksburg, Va., Cir. 533, Sept. 1954.*

## Soils

*"Contour Planting and Irrigating on Moderate-To-Steep Slopes," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 440, Sept. 1954, L. N. Brown.*

*"Second Annual Report of the Contra Costa County Irrigated Pasture Management Study for 1953," Agr. Ext. Serv., Univ. of Calif., Cowell, Calif., July 1954, J. Borden and A. Shultis.*

*"Studies of Soil Fauna With Special Reference to the Collembola," Agr. Exp. Sta., Conn. Agr. Exp. Sta., New Haven, Conn., Bul. 583, Jan. 1954, P. F. Bellinger.*

*"Soils of Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 278, Dec. 1954, P. R. McMiller.*

*"Summary of Soil and Water Conservation Research From the Blackland Experiment Station, Temple, Texas, 1942-53," Agr. Exp. Sta., College Station, Tex., Bul. 781, June 1954.*

*"Soil Survey, Blaine County, Nebraska," USDA, Wash., D. C., Series 1941, No. 13.*

## Crops

*"Report of the Minister of Agriculture for Canada for the Year Ended March 31, 1954," Ottawa, Ont., Can.*

*"Experimental Farms Service," Canada Dept. of Agri., Ottawa, Ont., Can., 1954.*

*"Dominion Experimental Station, Fredericton, N. B., Progress Report 1948-1952," Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Can., May 1954.*

*"Dominion Experimental Station, Saanichton, British Columbia, Progress Report 1947-1953," Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Can., Oct. 1954.*

*"Garden Rose Growing," Can. Dept. of Agr., Ottawa, Ont., Can., Pub. 908, July 1954.*

*"Annual Report of State Board of Agriculture 1953-1954," State Dept. of Agr., Dover, Del., Vol. 44, No. 3.*

*"Sweet Potato Variety Trials in Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-71, March 1954, V. F. Nettles.*

*"Coastal Bermuda Grass," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. N.S. 2, Sept. 1954, G. W. Burton.*

*"Reseeding Crimson Clover as a Major Honey Plant in South Georgia," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 1, Nov. 1954, J. H. Girardeau, Jr.*

*"Eighteenth Biennial Report, State of Idaho, July 1, 1952 to June 30, 1954," State Dept. of Agr., Boise, Idaho, 1954.*

*"Nutritive Values of Native Plants on Forest Range in Central Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 488, May 1954, R. S. Campbell, E. A. Epps, Jr., C. C. Moreland, J. L. Farr, and F. Bonner.*

*"Blossom and Twig Blight of Low-bush Blueberries," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Bul. 529, June 1954, E. N. Pelletier and M. T. Hilborn.*

*"Pasture Renovation," Agr. Exp. Sta., Univ. of Md., College Park, Md., Bul. 449, June 1954, A. W. Burger, T. S. Ronningen, and A. O. Kuhn.*

*"Flower Gardens," Agr. Ext. Serv., Univ. of Mass., Amherst, Mass., Lflt. A262, June 1954, A. W. Boicourt.*

*"Sixty-Seventh Annual Report of the Director, Mississippi Agricultural Experiment Station For the Fiscal Year Ending June 30, 1954," Agr. Exp. Sta., Miss. State College, State College, Miss.*

*"The Nutritive Value of Collards," Agr. Exp. Sta., Miss. State College, State College, Miss., Southern Cooperative Series Bul. 39, Aug. 1954.*

*"Nebraska Corn Performance Tests, 1954," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 41, Nov. 1954, A. F. Dreier, J. H. Lonnquist, V. F. Pumphrey, and P. L. Ehlers.*

*"Report of the Nevada State Department of Agriculture, For the Fiscal Years Ending June 30, 1953-54," State Dept. of Agr., Reno, Nev.*

*"New Strawberry Varieties," Agr. Exp. Sta., Cornell Univ., Geneva, N. Y., Bul. 762, March 1954, G. L. Slate.*

*"New Raspberry Varieties," Agr. Exp. Sta., Cornell Univ., Geneva, N. Y., Bul. 763, March 1954, G. L. Slate.*

*"Good Pasture," Agr. Ext. Serv., Ohio State Univ., Columbus, Ohio, Ext. Bul. 345, Aug. 1954, D. R. Dodd.*

*"Better Living with Agricultural Research," Agr. Exp. Sta., Wooster, Ohio, Bul. 755, Dec. 1954.*

*"Forage Crops, Evaluation and Management Studies, Progress Report, 1953," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Mimeo. Cir. M-261, May 1954, W. W. Huffine, J. Q. Lynd, and W. C. Elder.*

*"Rejuvenation of an Old Apple Orchard by Means of Fertilizers, Mulches and Cover Crops," Agr. Exp. Sta., Pa. State Univ., State College, Pa., Bul. 585, Nov. 1954, F. N. Hewetson.*

*"Sixty-Sixth Annual Report, 1953, of the Tennessee Agricultural Experiment Station," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn.*

*"Range Plants of Texas," Agr. Ext. Serv., Tex. A. & M. College, College Station, Tex., B-236, May 1954, A. H. Walker.*

*"Sweet Potato Variety Test, El Paso Valley, 1954," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1734, Dec. 1954, M. D. Bryant and P. J. Lyerly.*

*"Results of Buffelgrass Variety Test on the Blackland Experiment Station, 1952-54," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1735, Dec. 1954, E. D. Cook and W. R. Parmer.*

*"Poisonous Range Plants of the Trans-Pecos Area of Texas," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1736, Dec. 1954, J. W. Dollahite.*

*"Summary of the 1954 Texas Corn Performance Tests," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1732, Nov. 1954, T. E. McAfee, J. S. Rogers, R. P. Bates, and A. J. Bockholt.*

*"Wheat . . . A Major Cash Crop in Texas," Agr. Ext. Serv., Tex. A. & M. College, College Station, Tex., B-226, March 1954, F. T. Dines, I. M. Atkins, and K. B. Porter.*

*"Report of: Extension Service, Resident Teaching, Related Services, Experiment Station, July 1, 1952-June 30, 1954," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt.*

*"Increasing Your Feed Supply," Agr. Exp. Sta., Va. Polytechnic Institute, Blacksburg, Va., Lflt. 9, July 1954.*

*"Winter Hardiness of Stone Fruit Varieties in Irrigated Central Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 553, Aug. 1954, H. W. Fogle and F. L. Overley.*

*"Cranberry Growing in Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. 554, Sept. 1954, D. J. Crowley.*

*"Improving Production of Old Seeded Dryland Pastures," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Mimeo. Cir. 48, Aug. 1954, F. Rauzi, O. K. Barnes, and R. L. Lang.*

*"The Dasheen, A Tropical Root Crop for the South," USDA, Wash., D. C., Cir. 950, Nov. 1954, W. H. Hodge.*

## Economics

*"Crisis In Rice?" Agr. Exp. Sta., Univ. of Calif., Davis, Calif., Lflt. 34, Sept. 1954, G. L. Mehren.*

*"San Diego County Avocado Management Study 1953," Agr. Ext. Serv., Univ. of Calif., Berkeley, Calif., W. Sullivan.*

*"Alfalfa, Harvesting and Feeding," Agr. Exp. Sta., Colo. A. & M. College, Fort Collins, Colo., Bul. 417-A, May 1954, H. G. Sitler, W. E. Connell, R. T. Burdick, and S. S. Wheeler.*

*"Agricultural Statistics for Louisiana, 1909-1953," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 490, May 1954, J. P. Montgomery.*

*"Economic Appraisal of Farming Practices and Rotation Programs on Louisiana Rice Farms," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 491, June 1954, T. Mullins.*

# South Carolina's Peach Industry . . .

(*From page* 23)

years out of five.

The introduction of such varieties as Hiland, Redcap, Coronet, Keystone, Southland, Sunhigh, and July Elberta, all of which have chilling requirements short enough for the production of adequate yields, has made it possible for orchardists in more southern areas to plant peaches. Since the Piedmont section will normally accumulate from 200 to 300 hours more than the central and south-central sections of the State, the production of the varieties with short chilling requirements may prove rather hazardous in certain years. If the chilling requirement is completed by the end of December or early January, as is often the case, and is then followed by unseasonably warm periods in late January or February, premature fruit bud activity may occur and may result in a longer frost danger period.

Recent development in the field of cooling or precooling has been a major factor in the continued success of the peach industry. In the mid-forties experimental work was done on the use of ice water in the removal of field heat from peaches. In 1951 an experimental model using the principle of hydrocooling was run in South Carolina on a limited basis; however, in 1952 two hydrocoolers were run on a commercial basis. In 1953 there were 12 hydrocoolers in operation, and this number increased to approximately 30 in 1954.

The process of hydrocooling involves the removal of field heat from the peaches after they are packaged by running them through a water bath for a period of approximately 17 minutes. The temperature of the water bath is held as near 33°F. as possible through the addition of adequate amounts of ice. Data indicate that this process will lower the temperature of the peaches from approximately 90°F. field heat to 46 to 50°F. in a matter of 16 to 18 minutes. Approximately 20 pounds of ice are required to remove the above amount of field heat from one bushel of peaches.

Through the process of hydrocooling, the market acceptance of fresh peaches has greatly improved, particularly since 1951. The improved condition on arrival of fruit that has been hydrocooled has improved the demand since the receivers have a large measure of insurance of receiving fruit in good condition. Because of this insurance the buyers are more confident when purchasing fresh peaches. Hydrocooling makes it possible to put a much more desirable product in the hands of the consumers. By quickly removing the field heat, much more mature fruit can be moved to distant consumers in much better condition, and a higher consumption of peaches as fresh fruit is the result.

Another important milestone in peach growing is the use of organic pesticides for control of peach pests. Up until 1947 the major insecticide was arsenic of lead for the control of plum curculio and sulfur for the control of scab and brown rot, for summer spray. For winter spray, oil and concentrated lime sulfur were used for scale control, while concentrated lime sulfur and bordeau mixture were used for leaf curl control. Sulfur is still the most popular fungicide today; however, a new organic fungicide, Captan, has been introduced and is becoming more popular. This new fungicide gives as good control of brown rot as sulfur, and fruit sprayed with this fungicide seems to have a longer holding life. Perhaps its most favorable characteristic is that fruit is better colored when sprayed with this material, particularly under dry, hot weather conditions.

The most important of all of the new organic pesticides is parathion. This material has been classified as the nearest perfect insecticide for peaches that the growers have ever known, even though it is very toxic to warm-blooded animals unless used with proper precautions. The list of peach insects which this insecticide controls includes plum curculio, oriental fruit moth, aphids, tarnish plant bug, peach tree borer, lesser peach borer, and scale insects including Forbes, San Jose, and white peach scale. This insecticide has saved peach growers an untold amount of money not only through the prevention of loss of fruit but through the saving of labor once used in time-consuming supplemental measures, particularly in the control of plum curculio.

Supplemental irrigation is also becoming an important factor in peach production. Even though the average rainfall of South Carolina is approximately 45 inches, very few seasons pass without the need of additional water for the proper development and sizing of fruit maturing during the period of rainfall shortage. One grower who installed a portable irrigation system in 1947 has used supplemental irrigation at least once each summer since, including 1950, which was generally accepted as a year of adequate rainfall during the summer months.

Peach orchard irrigation dates back to the thirties when two Piedmont growers through the use of makeshift equipment found that applying additional water was worthwhile. In 1947 two growers in the State installed portable irrigation equipment, and since then irrigation has increased to the point that many thousands of acres of peaches are receiving additional water each summer. Even though the cost of irrigation equipment and farm ponds is rather expensive, most growers are taking the attitude that supplemental irrigation is good crop insurance. Most new plantings are made now with the possibility of eventually using supplemental irrigation. Most growers are planting as near a source of water as possible without sacrificing the characteristics of a good orchard site.

## Apparent Fertility Trends . . .

(*From page* 12)

the 10 Western States. These data were taken from Report No. 4 of the Fertilizer Work Group, National Soil and Fertilizer Research Committee, and published in mimeograph form August 1951. They show that in the 10 Western States, there are 1,897,000 acres of fruits and 1,001,000 acres of vegetables. The average nitrogen applied per acre for fruits and vegetables, was 58 and 56 pounds respectively. The average $P_2O_5$ added to fertilizer was 8 pounds in the case of fruits and 43.6 in the case of vegetables. The average $K_2O$ applied was 0.9 pound for fruits and 15.6 pounds for vegetables.

In Table III, these average usage figures for fruits and vegetables are shown in comparison with the average annual loss during the 15 years of the lysimeter experiment. These comparisons show that despite the substantial usage of nitrogen on fruits and vegetables, the average annual net loss from an irrigated soil under the conditions of our experiment was 248 pounds. Thus, it appears that we are not maintaining the nitrogen content of our soil despite the rather generous use of nitrogen fertilizer. We are gradually drawing on and depleting the reserve of this constituent in Western soils. Obviously, in the years ahead it will be necessary to add increasing quantities of commercial nitrogen fertilizer or to grow more and more legumes if we are to maintain the productivity with respect to nitrogen.

Our lysimeter data show an average annual removal of 65 pounds of $P_2O_5$

TABLE III.—COMPARISON BETWEEN AVERAGE USAGE OF N, $P_2O_5$, & $K_2O$ ON FRUITS AND VEGETABLES IN WESTERN STATES AND NET LOSSES—BASED ON A LYSIMETER EXPERIMENT—CROPPED ANNUALLY TO SUDAN GRASS.

| Element | Average annually applied per acre in 10 Western States | | Average annual net loss from an irrigated soil cropped to Sudan grass |
|---|---|---|---|
| | Fruits | Vegetables | |
| Nitrogen (N) | 58 | 56 | 248.0 |
| Phosphorus ($P_2O_5$) | 8 | 44 | 65.0 |
| Potassium ($K_2O$) | 1 | 16 | 285.0 |

(15.1 pounds P) per year, and this compares with an average addition to fruit trees of 8 pounds and to vegetables of 44 pounds. Thus we are doing pretty well with respect to vegetables; but in the case of fruit trees, the time will come when the reserve supply of available phosphorus will become limiting and commercial application of phosphorus will be necessary to maintain production.

The most striking contrast is afforded by the potassium figures. The lysimeter data show an annual removal of 285 pounds of $K_2O$, whereas average usage in the 10 Western States amounts to 1 pound per acre per year on fruit trees and 16 pounds on vegetables. The obvious reason for this is that most of our soils are naturally rich in potassium. To date economic returns from potash application have not been obtained under many instances. However, it is very clear that the time is coming when it will be necessary to apply substantial amounts of potassium to irrigated soils in order to replace that removed by crops together with the small amounts annually lost by leaching under irrigation agriculture.

These data illustrate one aspect of our efforts to determine the long-term trends of chemical, physical, and biological changes in soils under the impact of cropping, fertilization, irrigation, etc. We are currently broadening our studies of this question, to the end that we may anticipate before crop production begins to decrease for unaccounted reasons, the long-time changes to be expected from various fertilizer and management operations. Steps can then be taken to maintain the soil continuously in a highly productive state.

# Seven Steps to Good Cotton

(*From page* 10)

being planted in Mississippi in 1928. In 1954, 97% of the cotton acreage in Mississippi was planted to Deltapine, Stoneville and Coker varieties of cotton.

### *Fourth Step*—Make Your Labor and Equipment Count

A few cotton farmers have produced 3 bales per acre at 9 cents per pound of lint. Many have produced 2 bales per acre at 12 to 14 cents per pound of lint. The majority of cotton farmers produce ¾ bale of lint per acre at 23 cents per pound of lint.

One man and one mule with one-row equipment spend 160 man hours to grow and harvest one bale of cotton per acre. By complete mechanization, it has been done with 17 to 28 man hours for one bale per acre. Mechanical hill-dropping, 9 to 12 inches apart, and use of pre-emergence chemicals save 1 chopping and 2 hoeings. With machinery, the seedbed is prepared when soil conditions are right and better stands are ensured.

The cheapest method of grass and weed control is to drill 2 bushels of cottonseed per acre. After the stand is ensured, cross-plow on 40-inch spacings, leaving 10 inches of drill with 5 to 15 plants per hill. Spacings of 2 to 3 plants per hill 9 to 12 inches apart in the drill on 40-inch rows give maximum yields per acre over a period of years.

Shallow cultivation with low-crown, high-speed sweeps preserves moisture and allows the roots full feeding range of the middles.

Insecticides may be applied with tractor equipment as either a dust or spray. It is cheaper to do early insect control with a sprayer than with a duster. An airplane is used for late season insect control with either dust or spray, when cotton is too rank for ground equipment.

It is more economical to harvest with mechanical pickers when hand pickers cost $3 or more per cwt. of seed cotton.

In 1930, an average-size farm family of 5 grew and picked 12 to 16 acres of cotton. Much of this on-the-farm labor found higher wages in industrial towns. At present, most of the extra farm labor is hauled from nearby towns to chop, hoe and pick much of the cotton crop.

### *Fifth Step*—Control Diseases and Insects

Cotton seedling diseases destroy stands of cotton every spring at a great loss to farmers. Perfect stands are ruined for maximum yields, and replanting is necessary. The delay of 2 weeks in planting date costs cotton farmers ⅛ to ¼ bale of cotton per acre. Seed treatment and planting on a firm, well-drained seedbed help ensure better stands of cotton. Roots of the cotton plants must be in healthy condition at all times for highest yields per acre. The plant nutrients, phosphate and potash, help develop healthy root systems.

Cotton insects harass the seedlings from germination through maturity. Cutworms are considered the first seedling enemy. Thrips attack the tiny bud as soon as the 2 seed leaves unfold. One or two early spray applications of any of the recommended insecticides at 7-day intervals protect the plants and

**Fig. 7. Loss of top crop can be due to many factors—lack of moisture, insufficient amounts of nitrogen and potash, poor late insect control, deep cultivation, or hot winds causing top crop to shed.**

**Fig. 8. Some farmers are following a 2-year rotation of corn and cotton. With higher rates of fertilization, more organic matter is produced to maintain higher yields.**

help save a good stand. Protected leaf-buds are allowed to grow and help feed the young cotton plant roots, hence stronger plants are obtained. When tiny squares begin to form, fleahoppers and thrips begin their damage. An application of any of the cotton insecticides, dust or spray, will control these pests.

When the squares get 7 days old, boll weevils coming out of winter hibernation quarters begin to puncture the squares. Boll weevils come out of hibernation during warm, rainy days. One boll weevil can puncture 7 squares a day. With 200 to 500 boll weevils per acre, not counting fleahoppers and thrips, the young growing cotton plants can be stripped of all squares. It costs less per acre to control insects early, when needed, than to try to control them late in the season. Three applications of any of the new organic insecticides applied at 4- to 5-day intervals will check all insects in the early season growth of the cotton plant.

When the plant begins to bloom and bolls are being formed it is very important to keep boll weevil infestation below 10%. Bolls must be retained on the plants early to use early moisture and minerals at a time when the cotton plant can best utilize them. It has been shown that 86 bolls formed from the first week of blooming make a pound of seed cotton, as compared to 161 bolls formed from the fourth week's bloom. Unless farmers have irrigation available, they must set their crop early for most economical yields. Supplemental irrigation when needed keeps the cotton plant fruiting rapidly. If needed, shallow cultivation helps to prevent shedding of squares at the peak of squaring and blooming.

Proper timing of all production practices and proper management of a complete insect control schedule enable the cotton plants to put on and hold a maximum crop. The bolls are more evenly distributed over the cotton stalk. Loading a stalk with a uniform boll crop dwarfs the size of the stalk, and this enables farmers to harvest a higher per cent of the crop on wet years. The cotton plants continue to grow, fruit, and retain bolls until moisture, nitrogen, or potash becomes a limiting factor in production.

The most common failure of the masses of cotton farmers in Mississippi is to quit poisoning too soon. One-fourth to one bale per acre is lost from failure to protect young bolls late in the season. Over the average period of years, bolls destroyed by boll worms and weevils cannot be replaced by the cotton plant. The first reason is lack of time, because it requires 52 to 78 days for a square to form, bloom, make a boll, and grow to open maturity. Too, the average early killing frost date of October 16 in North Mississippi prevents farmers from harvesting a top crop one out of five years. The most serious handicap is extreme dry weather like August 1952, which caused the top bolls to shed and rendered the plants unable to replace the bolls lost.

With all these practices—100 pounds of nitrogen per acre balanced with other minerals, especially potash, beginning early with complete insect control (12 to 21 applications, if needed), irrigating when the cotton plants need water, cultivating shallowly and only when needed—the cotton plants are able to put on 2 to 3 bales per acre, and at a profit.

### *Sixth Step*—Pick and Gin for High Grade

This precaution is to preserve the spinning qualities of the lint. If needed, defoliate cotton when top bolls are 25-30 days old. Cotton plants heavily loaded with a uniform distribution of bolls will defoliate easier than unbalanced plants. When farmers neglect to apply irrigation water or to apply the right number of applications of insecticides to protect normal growth and fruiting of the plants, complete defoliation is hard to obtain. Defoliation is an aid to mechanical harvesting. It allows sunlight to dry out large bolls on the lower part of the plants; it prevents boll rot; it helps drive out boll weevils at a time when young or late top bolls are being consumed. A saving of $15 to $35 a bale is realized if proper care is taken in field harvesting and handling of seed cotton before it is ginned.

### *Seventh Step*—Market for Grade and Staple Value

An additional $5 to $15 per bale to the farmer may be realized if he studies the cotton markets before he sells.

### Summary

By way of summary, we can say that the complete cotton production program works in Mississippi. Any farmer who leaves out any one of the many practices discussed cuts his cotton yield. A low yield means low income and unhappy farm families. High yields mean high net income and happy farmers. If cotton as a fiber is to compete with synthetic fibers, farmers must grow cotton at a cheaper cost per pound of lint.

# Heavier Potash Applications Now Recommended

SOIL scientists at the University of Illinois have upped their potash recommendations for soils that show potassium deficiency. The result will be more available potassium in the soil to provide for maximum crop yields.

These new recommendations follow the demands of higher yield levels. At the same time they are expected to increase reserve potassium.

The Illinois test for available potassium was first developed by R. H. Bray of the University of Illinois more than 20 years ago. S. W. Melsted, also of the University, and Bray together have revised the test recommendations.

To point out the difference in the

potash recommendations, C. M. Linsley, Soils Extension Specialist of the University of Illinois, gives the following example of a soil testing low in available potassium:

At old rates, 270 pounds of 60 per cent muriate of potash were recommended for a four-year rotation. The revised recommendations, however, call for 400 pounds of the same fertilizer, an increase of 130 pounds per acre.

And for soils showing a slight amount of available potassium, the new recommendations call for 300 pounds of muriate of potash over the four-year period. This is an increase of 180 pounds over the original recommendations.

These changes do not mean that the old recommendations were wrong, Linsley says. Those amounts were sufficient for the level of production on most farms and were considerably larger than many farmers have been willing or able to use.

But they were not sufficient for the higher yield levels expected now, and they were not enough to build up an adequate supply of available potash in the soil.

The revised recommendations will be used by 80 county soil-testing laboratories and by commercial soil-testing laboratories that are cooperating with the University of Illinois soil-testing laboratory.

## Fruit Fertilization in New Jersey

(*From page* 20)

increased if the trees indicate a need for more, but this must be determined by the grower. Most apple trees require from ½ to 1½ pounds of actual nitrogen annually. The amount required depends on several factors, and the variety is a major consideration. Stayman and Rhode Island Greening, for example, often do well with ½ to 1 pound of actual nitrogen per year. Rome and Red Delicious can use 1 to 1½ pounds in most orchards, and in many orchards Red Delicious has given good response with more than 1½ pounds of actual nitrogen. As a basic application ½ to ¾ pound of 8-8-8 for each year of age annually is a rule that has worked out quite well for bearing apple trees. A 20-year-old apple tree will receive from .8 to 1.2 pounds of nitrogen by this practice. Growers' experience, variety, and individual orchard conditions will necessarily call for adjustments, but this does seem to provide a safe range generally for soils of "average fertility."

All of us have been using soil analyses to help in providing the grower with the best suggestions regarding fertilization. More recently, tissue analysis has been added to make our recommendations more accurate. However, it will always be necessary to walk in the orchard, spend some time with the grower, and see the fruit during the growing and harvest season in order to make the best possible recommendations. One needs all the clues possible, and an examination of the trees and fruit cannot be omitted.

Some of the most successful apple growers are using the sod-mulch system of soil management. The constant use of mulch under the trees may necessitate a fertilizer program quite different from one of clean cultivation, and cover crops. Potassium accumulates in the soil under mulch. In one Delicious orchard on a sandy loam soil, the pounds per acre of potassium in the top foot of soil under a corn cob mulch after two years of mulching were 480, under alfalfa hay 270 pounds, and with no mulch 80 pounds. Soil samples were taken in October, which was an exceptionally dry month, and this may account in part for such high readings. The orchard was in a trashy cultivation with winter cover of rye grass mainly. This is an exceptionally high reading of potassium, and with such a reading no additional potassium need be applied for at least one year.

The application of fertilizer to mulch material in the field where it is growing has been shown by U. S. Department of Agriculture workers to be an excellent means of supplementing the fertilizer applied to apple trees. The sod-mulch system is hard to beat for apples.

Fruit trees are able to use fertilizers more efficiently when the soil has a pH of 5.5 to 6.5. It is recommended that the grower try to maintain the pH at about 6.0. The area beneath the tree is often more acid, and it is important that this area be sampled separately from the middles. Liming under the tree is necessary, and this often must be done by hand.

A discussion of fruit fertilization would not be complete today if we did not include a few comments regarding the use of the newer fungicides and insecticides on fruit plants. We are all familiar with the injury the copper fungicides can cause to foliage. Grapes make healthier growth with larger, darker green leaves and yield more fruit when sprayed with Ferbam instead of bordeaux.

Apple trees likewise show considerable improvement in vigor since the use of Captan as a fungicide has become rather general in our orchards. The use of milder spray mixtures and the resulting improved condition of the foliage of our fruit plants cannot be overlooked as we discuss fertilization and fruit culture. Plants with healthy leaves are able to utilize more efficiently the fertilizers we apply.

## Small Fruits

The three important small fruit crops in New Jersey are blueberries, strawberries, and cranberries. Blueberries growing on those soils that contain a good supply of partially decomposed organic material grow well when fertilized twice during the growing season. The total amount of fertilizer applied per acre ranges from 500 to 1,000 pounds of an 8-8-8. The amount depends mainly on the age of the plants and soil fertility. The fertilizer is equally divided and half applied at the end of April and half in the first week in June. Fields showing nitrogen hunger at the end of the harvest benefit from a third application of the same amount in October. Blueberries grow well at a soil pH around 4.8. Growing on the upland, or mineral type soils, they may require more fertilizer or more frequent applications. A few growers on the upland soils are making three applications, one each in April, May, and June, with apparent success. Ammonium sulfate is the most satisfactory source of nitrogen on these soils if the pH is above 5.0.

Strawberries are fertilized rather heavily during the first growing year. A 5-10-5 is most generally used, and the total amount applied per acre may equal a ton for the year. The object during the first year is to keep the plants vigorous and producing runner plants. The final application should be made before September, since this precedes fruit bud differentiation. During the spring of the fruiting year, nitrogen only is sufficient if the field was well fertilized with NPK the previous season. About 30 pounds of actual nitrogen are a safe beginning on the more sandy soils. More can be applied even after bloom through the irrigation lines if it is needed. On fertile loam soils, fields may not need any spring nitrogen. Sodium nitrate is most generally used, and in recent years urea has been satisfactorily applied with irrigation water.

Recent studies in cranberry fertilization have shown that a 1-1-1 ratio is most satisfactory. A 7-7-7 mixture is being used in a present experiment, and the most satisfactory timing of application is June 15 and August 1, using 150 pounds per acre each time. The use or omission of magnesium did not affect total yield or berry size. Berries were significantly smaller where potassium was omitted. One hundred pounds of 8-8-8 per acre in October are recommended for those bogs showing nitrogen hunger.

This brief discussion of fertilizer recommendations for fruit is from an Extension viewpoint. There are many puzzling questions asked by growers, and often it is difficult to find the answer, even after we dig into the literature. Many growers carry on "experiments" of their own and are convinced that this or that mixture is superior to a more standard mixture. Some growers do a good job of demonstrating the superiority of one method or material over another.

Many of these mixtures now being tried contain trace elements. No mention was made of trace elements in this article, because there are no general recommendations that we feel can be made. Beneficial results have been obtained by the use of some trace elements. Boron on apples and manganese applied on peaches and strawberries have improved plant growth and yields. These deficiencies were observed in certain plantings and specific recommendations were made. Manganese deficiency was found where the soil pH was above 6.5, due to over-liming. Generally this is not the case. Manganese deficiency has been observed in one apple orchard where the pH is below 6.0. Such conditions require careful diagnosis and specific recommendations. We should be able to do a much better job regarding trace element fertilization as long-term research projects begin to yield data. Experiments in fruit fertilization and especially those in orchards, blueberries, and cranberries are time-consuming and years of data are needed before general recommendations can be prepared and presented.

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## Shortages of Potash . . .

(*From page* 16)

ages of any of these elements were found when the deficiency indices were calculated from the standard values. This lack of relationship indicated that there was no consistent deficiency of any of these nutrient elements. However, a wide range in their composition was found for all of the nutrient elements which indicated that any one, or more than one, of them may have direct bearing upon production in individual vineyards.

### Potash Fertilizer Trials—1954

During the spring of 1954 four potash fertilizer treatments plus an untreated check were established in each of six different Concord vineyards. The treatments were as follows: Muriate of Potash (KCl) applied at rates of 300 and 150 pounds per acre; and potassium sulfate ($K_2SO_4$) applied at rates of 360 and 180 pounds per acre. These treatments represent two rates each of 180 and 90 pounds of actual potash ($K_2O$) to an acre, applied to single rows of 40 to 95 vines. Each plot also was fertilized with 50 pounds of actual nitrogen to an acre.

Initially, the six vineyards were at different nutritional levels of potash as well as calcium and magnesium. Three of them were in various stages of potash deficiency. A fourth was low in potash, but no potash-deficiency symptoms were apparent, perhaps because calcium and magnesium also were very low. A fifth vineyard had higher than average amounts of potash in the soil, but potassium-deficiency symptoms appeared on the leaves, probably due to very high calcium and magnesium levels in the soil. The sixth vineyard had adequate amounts of all nutrients, and no deficiency symptoms were apparent.

Vines in the fertilizer trials were carefully observed during the season for symptoms of potassium deficiency or other growth patterns. At harvest time fruit yield and soluble solids data were taken on all plots.

### *High Levels of Potash Increase Grape Yields*

By late July it was evident that the potash applications benefited vineyards which were suffering from potassium shortages. Plots which received the high levels of potash (180 pounds actual potash per acre) had no visual symptoms of potassium deficiency, were vigorous in growth, and usually had large well-formed bunches of grapes (Figs. 2 and 5). The vines fertilized with medium levels of potash (90 pounds actual potash per acre) had moderate potassium-deficiency symptoms (Fig. 4). Their vigor and bunch size were better than the checks but not as good as those in the high level plots. When compared with vines not receiving potassium, the potassium content of petioles from vines receiving medium levels of potash was only slightly increased. Medium applications of potash may not have increased petiole potassium the first season because of the utilization of potassium in more growth. The check plots exhibited pronounced symptoms of potash deficiency which became progressively worse as the season advanced toward the harvest period (Fig. 3). Vines in the check plots made too little growth, and in most cases the grape bunches and individual berries were smaller than on the vines receiving high levels of potash (Fig. 5).

At harvest time significantly higher yields of fruit were taken from the high potash plots than from either the medium potash or the check plots. In the Horace Hayne vineyard, which was previously very low in potash, the yield was increased by more than 1½ tons per acre (Fig. 6). In the same vineyard the per cent soluble solids of the fruit at harvest time averaged 15.1 on the check plot and 16.6 per cent on the high potassium chloride plot. The plots receiving medium levels of potash had yields which were about the same as the check plots.

These first-year results indicate that potassium deficiency can be largely corrected, resulting in good growth and increased yields of fruit during the year of initial application of either potassium sulfate or potassium chloride at rates of 180 pounds per acre of actual potash. Potash applied at 90 pounds per acre materially increased growth and reduced deficiency symptoms but was not always sufficient to increase yields significantly the first season.

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# What Determines Forage Quality?

(*From page* 26)

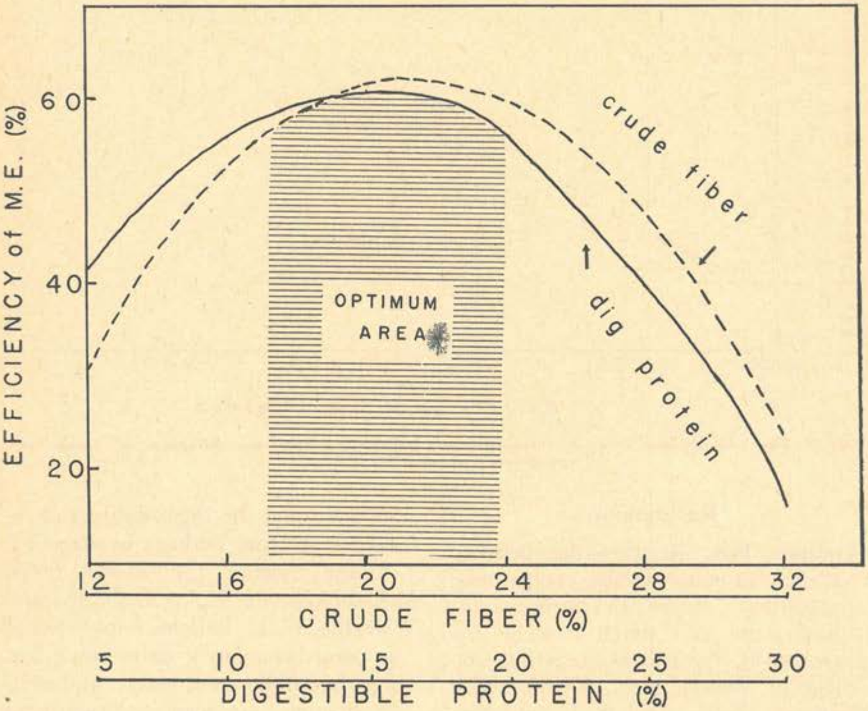


**Fig. 2. The effect of crude fiber and digestible protein content of the ration on the use of feed energy (Axellson, 1953).**

### Forage Intake

Another factor that has been studied in recent years is the effect of forage quality on the amount of forage an animal will consume. Although the change in nutrient composition and digestibility may or may not have a direct bearing on forage intake, such changes are useful in describing the conditions necessary for high levels of intake. McCullough, working with dairy cows, reported a correlation of 0.51 between dry matter digestibility and dry matter intake. Brannon, working with steers, reported a correlation of 0.82 between the same factors. Thus a part of forage quality in general is its effect on intake.

### Summary

To be of use in providing a source of feed for livestock a forage must produce an adequate quantity of dry matter per acre. However, the mere production of forage dry matter does not insure desirable levels of animal production from the animals consuming the forage. Such factors as effect on animal health, relative bulkiness, the effect of changing composition (both physical and chemical) on forage intake, digestibility, and ration balance apparently determine the usefulness of the forage dry matter produced. Studies which include all factors should provide information which may permit high levels of animal production from forage alone.

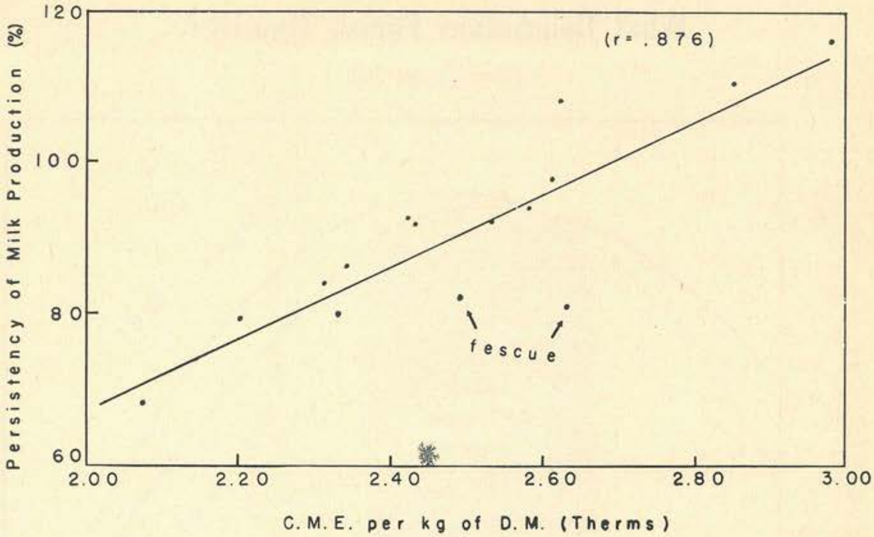


**Fig. 3. The relationship between calculated metabolizable energy per kilogram of forage and persistency of milk production.**

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# Formula Farming

(*From page* 5)

They found that certain chemical substances which they could make in the well-equipped laboratory caused plants to react in a sensitive way, and finally that animals and humans could also be affected. The growth regulators gave the first of these newer results. In 1943 a patent was secured for one of the strongest of these plant regulators, which is 2,4D. It was found to be so potent that a millionth part of an ounce might promote fast growth in some species but was sure death to many broad-leaved plants. The selective action thus obtained with this first important member of the plant hormone family to a great extent relieved the grain grower from the back-bending job of hoeing and hand pulling, or the alternative of outright abandonment of a weed-infested field.

In quick succession under the spur of the original discovery, chemists made combinations that gave us a wide variety of useful synthetic weed killers. In that earlier list were 2,4,5-T, IPC, and TCA. But that wasn't all, because the new marvels of the laboratory were not restricted to noxious weed control.

The prevention of premature shedding of fruit in orchards by applying indolacetic acid is just one example.

Then the thinning of fruit buds to get fruit of larger size and better quality by sprays of naphthalenacetic acid absolutely reduced the manpower needed to perform all that tedious hand-thinning which was a bugaboo in the western states. More than 25,000 acres of apples in the Pacific Northwest received such thinning chemicals in a recent season. Hydrazide of maleic acid in a strong spray delays bloom to a safer time after frost.

Getting rid of plant leaves after their main function is over, and their presence is a sort of nuisance, opens up another great arena of action for the modern chemist. In cotton production alone this system now known as "defoliation" has meant millions of man hours saved and much enhanced net income. Cotton leaf removal by chemicals was unknown nine years ago. By 1950, only three years after trials began with defoliants, fully 10 per cent of the main cotton crops were treated that way.

The reasons for such universal application of leaf-shedding chemicals are easy to find. Old Sol shines into the plant better and the air currents flow through better so that the uniform harvest is advanced. Insects are bereft of hideaways. Diseases like boll rot are reduced. The miserable weevils hustle themselves out of leafless cotton plants in a hurry.

Not only has there been small if any damage to the cotton by means of these leaf removers, the use of some of them appear to add calcium and nitrogen to the soil—thus making them double purpose. On a much reduced cotton acreage ahead, this increasing use of fertilizers, chemicals, and mechanical pickers and other appliances suggests that a sharply reduced demand for labor in the mass is sure to come shortly.

Potato growers lately have gone the cotton growers a few steps further. It is now a common practice for them to destroy the entire potato vine above the ground. Mechanical means for this job have largely been replaced with non-selective herbicide chemicals. Tubers matured on topless plants are sounder and firmer and often escape the attack of late blight which starts in the leaves and stems.

One is not giving a complete index of the help to rural areas through chemistry without reference to the use of insecticides and fungicides that make people less susceptible to illness derived from animal parasites or fungous diseases. In the deep South such sickness has been notable in the past—mostly from malaria and hookworms. Since better control and eradication of many of such threatening insects and bacteria have come to us, the resulting improvement in health and mental attitudes has meant far higher productivity and earning power.

NOT long ago I saw what is reputed to be a good estimate of the toll taken by bugs and worms, fungi, weeds, and plant and animal diseases. It claimed that in 1950 fully 13 billion dollars toll in destructive ravages and loss was suffered that way out of a valuation of 31 billions in cash receipts and home use. This would put the total agricultural injuries through such pests at about 40 per cent of the gross production.

This did not include all the sickness caused by insect-borne or fungous diseases, plant poisons, and the eating of spoiled animal products. Modern sanitation for all foods from farm and ranch to the dining table employs innumerable protective and disinfecting chemicals whose guardianship of the people is really part and parcel of the agricultural dependence upon them.

One discovery begets another. Talk about your atomic chain reaction! Agricultural chemistry has it too. When any effective new chemical is found and tested, farmers want it in a hurry and they need the best facilities to apply it to their crops and stock. The old simple hand-sprayer is still used to dose the insects and diseases, but in its wake comes a great array of modern power apparatus, including the economical, low-gallonage machines and, of course, the advent of the airplane shooting sprays and dusts from the skies.

THE modern, low-gallonage sprayer gave the airplane all the zip needed to meet the situation. It allowed a coverage of 30 or 35 acres with every loading, which contrasts with only 3 to 5 acres previously with former equipment. It is surely convincing to compare the average time required for dusting, seeding, spraying, and fertilizing from airplanes with that of manual operations at the same jobs.

Down in the Southwest the seeding of rice on 100 acres using 5 or 6 trained workers took 30 hours at best. A plane pilot and 4 skilled workers can do it in about half an hour. In the same way and using the same acreage and workmen, cotton dusting that once took 60 hours is now done in less than one hour. Cotton defoliation has been speeded up from 60 hours to half an hour, with weed control operations taking about the same comparable time. Quick action to stop sudden pest invasions, the ability to cover areas too soft or rough to make hand work easy, and the elimination of injury to plants by heavy machinery are all part of the consideration with airplane crop protection.

Pelleted or coated seeds represent still another rather recent addition to the equipment that modern farmers use. Here again chemistry enters the picture. The seeds are moistened with hydroscopic adhesive and coated with a mixture of feldspar and fly ash. Others are covered with an aluminum silicate. Within the package to be sown by air are placed insecticides, herbicides, and fungicides as required; likewise hormones and stimulants. Of late several firms have sold soil conditioners made of a chemical that aerates soils and helps them retain water without cracking or caking. The invasion of all branches of farming by formula finders is almost complete.

Time was when any young fellow with good health and lots of energy and ambition—plus farm experience—might reasonably look ahead to the ownership of a sizable farm in his community. All he really needed 40 years ago was to be industrious and honest. But in modern situations we find our young man confronted with an almost absolute need of ample credit from somewhere, owing to the large expense involved in equipping and running a farm which is intended to be profitable. Besides that, he discovers that a college education or a term of specialized training elsewhere is nearly as necessary as money reserves.

THE rapid growth of scientific agriculture, especially the chemical side, looks from our corner like a movement that means fewer but better trained operators. The fewer persons equipped with all these ever-expanding chemical chore-boys will be able to produce greater and greater volume. From my viewpoint, all this chatter about not being able to feed our citizens 40 years from now is just a big wind.

America will always have a full plate, thanks to science. But filling that plate is bound to cost more in terms of farm equipment and facilities. That's because we have an army of folks standing behind the plowman—the hosts who make and sell and deliver and demonstrate all these wonder drugs and synthetic compounds, as well as the machinery and the fertilizers he uses.

Remember when we kids of high school days thought of the chemistry department as just an odorous nuisance? The kids who stuck to it, though, are now in the agricultural driving seat. The rest of us can stand back and gawp and wonder at the vast changes that a short time has wrought.

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Monkeys have a good time because there are so many of them and there are so many of them because they have a good time.

* * *

A city dweller who was traveling through New Hampshire noticed a cornfield on a rather steep hillside. Seeing a farmer standing in the doorway of a farmhouse, he stopped his car and pointed to the cornfield.

"How do you plow that field?" he asked. "It looks very steep."

"Don't plow it," replied the farmer. "When the spring thaws come, the rocks rolling down the hill tear it up."

"That's wonderful," said the city fellow, "but how do you plant it?"

"Don't plant it, really. Just stand in my back doorway and shoot the seed in with a shotgun."

"Is that a fact?" gasped the man from the big city.

"Gosh, no!" said the farmer. "That's conversation!"

* * *

The conscientious father was dispensing advice to his son who was about to be married.

"Cooperation is the foundation of successful marriage," he said solemnly. "You must do things together. For instance, if your wife wants to go for a walk, go for a walk with her. If she wants to go to the movies, go to the movies with her. If she wants to do the dishes, do the dishes with her."

The son listened dutifully, then asked: "Suppose she wants to mop the floor?"

When Judy returned from school one day, she remarked casually: "Mother, I told my teacher that you threw the hairbrush at Daddy this morning."

"Why on earth did you tell her that?" asked her mother in horror.

With devastating logic, Judy replied, "Well, she didn't know it."

* * *

A bride and bridegroom came down to breakfast in the hotel where they had spent the first night of their honeymoon.

"Now, be casual and offhand and they won't know we're newly-weds," cautioned the groom.

While he studied the menu, his bride gave her order to the waiter. "Tea and toast without butter, please."

Whereupon her husband exclaimed in a voice everyone in the place could hear: "Good Heavens, is that all you eat for breakfast?"

* * *

The Army psychiatrist wanted to be sure that the newly enlisted rookie was perfectly normal. Suspiciously he said:

"What do you do for your social life?"

"Oh," the man blushed, "I just sit around mostly."

"Hmmm—never go out with girls?"

"Nope."

"Don't you even want to?"

The man was uneasy. "Well, yes, sort of."

"Then why don't you?"

"My wife won't let me, sir."

Better Crops with PLANT FOOD

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