Title: Pennsylvania vegetable growers' news, v. 7

Place of Publication: State College, Pa.

Copyright Date: 1937

Volume:
7

PENNSYLVANIA VEGETABLE GROWERS' NEWS

Volume VII March, 1937 No. 1

Publication of the Pennsylvania Vegetable Growers' Association
John M. Willson, Belle Vernon - - - - - - - - President
A. C. Thompson, Morrisville - - - - - - Vice- President
W. B. Mack, State College - - - - - Secretary-Treasurer

The Annual Meeting, held in Room E of the Farm Show Building, was attended by a greater number of members and visitors than any previous meeting of the Association. The scheduled speakers and discussion leaders all were in attendance, and all topics on the program were presented and discussed with lively interest, to the profit of everyone participating in the meetings.

At the business sessions, all officers for 1936 were renominated for 1937 by motion of the Nominating Committee, which was passed unanimously. Members of the Nominating Committee which introduced the motion were Stanley Becker, Karl Huber, and J. M. Huffington. Nominations were closed and the officers were reelected on motion by H. S. Mills, seconded by R. R. Brader, and passed unanimously.

The Secretary-Treasurer reported receipts of $167.61 and expenditures of $90.56, leaving a cash balance of $77.05 as of January 19, 1937.

On motion by Stanley Becker, seconded by H. S. Mills, the Pennsylvania Vegetable Growers' Association was affiliated with the Vegetable Growers' Association of America.

R. R. Brader's report of his services as a representative of the Pennsylvania Vegetable Growers' Association on the Agricultural Council of the state was received with approval.

Resolutions were adopted as follows:

1. In appreciation of studies on markets carried on by the Department of Agricultural Economics of the Pennsylvania State College and reported at this meeting by Mr. R. B. Donaldson.

2. In appreciation of the efforts of the Pennsylvania Ten-Ton Tomato Club Committee, in particular of its Chairman, Mr. Harry W. Huffnagle, and of Mr. J. M. Huffington, in organizing the Pennsylvania Ten-Ton Tomato Club for 1937, and in obtaining funds for prizes, certificates, and the publication of a report.

3. In request for extension of investigations of the fertilizer requirements of soils by means of rapid soil tests, as reported by Dr. Fred G. Merkle of the Department of Agronomy of the Pennsylvania State College.

4. In establishment of a Research and College Relations Committee of this Association, to consider the research needed by vegetable growers, and to confer with the Pennsylvania State College and Experiment Station in an effort to meet these research needs.

5. In request of the State Legislature for enlarged and more comfortable meeting-rooms and more facilities for the Annual Meeting in the Farm Show Building.

6. In request for an amendment to the State Constitution to prevent the use of funds from automobile and truck registration for uses other than improvement of highways.

7. In request for additions to the appropriations made in the previous legislative biennium, to enable the proper authorities to purchase and administer natural foods, such as fruits, vegetables, eggs, and milk, as well as the vitamin concentrates now being purchased and administered to undernourished school children.

Brief summaries of their talks by the different speakers who led discussions in the Annual Meeting, January 19 and 20, 1937, are presented, herewith.

Methods Used in Producing Yields of High Quality Tomatoes

By Abram B. Earhart

Variety - Marglobe.

Plants - Southern.

Manure - Ten tons of stable manure per acre.

Soil - Medium loam; grass in 1934 and corn in 1935; plowed 7 inches deep in April; disced once, harrowed twice, and rolled once.

Fertilizer - 3-12-5; 650 pounds per acre; side of row after planting.

Planting - May 14 with transplanter, water applied in the hill; 95% stand; spaced 5 by 3 1/3 feet apart.

Cultivation - Deeply at first, then shallow; three times double, twice single and hand weeded once.

By John F. Landis

Variety - Marglobe and J.T.D.

Plants - Georgia certified.

Manure - Ten tons of stable manure per acre.

The Pennsylvania State College
School of Agriculture and Experiment Station
Division of Extension
M. S. McDowell, Director

TEN-TON TOMATO COSTS AND PRODUCTION PRACTICES IN 1936

Jesse M. Huffington, Specialist in Vegetable Gardening Extension,
and
Monroe J. Armes, Specialist in Farm Management Extension

DISTRIBUTION

Pennsylvania - 276

Counties

Adams	3	Cumberland	6	Northumberland	3
Bucks	41	Delaware	5	Philadelphia	1
Chester	9	Franklin	10	Union	1
Columbia	2	Lancaster	189	York	6

VARIETIES

Marglobe alone on 90 farms, Baltimore (Stone) - 34, Rutgers - 13, Bonny Best (Landreth) - 2, Pritchard - 1, and Penn State - 1.

PLANTS

Home-grown plants were used on 124 farms and southern plants on 128 farms. In 1935, however, only two out of 44 ten-ton yields were produced from southern-grown plants.

Close supervision, certification, and favorable weather during the shipping season, apparently, were factors influencing the condition of southern plants in 1936. Objections mentioned most frequently regarding southern plants were diseases and poor condition upon arrival. The best plants, including home-grown, were neither hardened too severely nor soft and succulent, and had good root systems. The demand for locally grown plants was greater than the supply.

Seedling plants, started early in April in coldframes and managed carefully, were generally satisfactory in the southeastern counties. Disease prevention practices, liberal spacing, and proper hardening helped to produce plants with thick, purplish stems and green, healthy tops. Larger root systems and greater uniformity of size is possible with the use of "spotted" or transplanted coldframe plants.

SOIL TYPES, ROTATIONS, AND PREPARATION

The largest number of ten-ton yields were produced on medium to heavy soils, as follows: medium - 168, clay loam - 65, and sandy loam - 30.

The use of green manure crops and stable manure to increase the amount of soil organic matter was generally considered to be an important factor influencing the yield especially on sandy loam and shale soils. The importance of careful and thorough soil preparation and of working the soil only when in the proper moisture condition were stressed particularly by growers having heavy clay loam soils.

The rotation most commonly followed was sod in 1934 (67% of 228 farms), corn in 1935 (70%), and tomatoes in 1936. In Lancaster County (1936) the yield following sod (1935) was an average of 12.82 tons on 47 acres and was 12.72 tons following corn on 457 acres.

Plowing was done before April 15 by over half (52% on 262 farms) of the ten-ton growers. This, no doubt, was a factor influencing the yields after sod.

The ground was disced and harrowed (combined) three to four times on 53% of 265 farms.

MANURE AND COMMERCIAL FERTILIZER

Most of the ten-ton yields (58% of 264 farms) were produced with an application equivalent to 10 tons of manure per acre, containing approximately 115 pounds of actual plant food, and 500 to 1,000 pounds of commercial fertilizer containing 100 to 150 pounds of actual plant food. For example, 750 pounds of 0-12-5 fertilizer contain 117 pounds of actual plant food, 4-16-4 - 180 pounds, and 4-8-5 - 127 pounds. Organic matter also is supplied in the manure.

Only six of the ten-ton yields were produced without commercial fertilizer and only 28 without manure being applied preceding tomatoes.

HIGHEST YIELDS WITH LIBERAL AMOUNTS OF PLANT FOOD

Manure and Fertilizer lbs. Actual Plant Food	6 Tons per Acre 10-11	12-13	14-20	Farms Numbers
Less than 150	56%	33%	11%	27
150 to 249	50%	33%	17%	153
More than 249	38%	29%	33%	84

The most common analysis of commercial fertilizer used was 3 to 4% nitrogen, 12 to 16% phosphoric acid, and 4 to 7% potash.

ANALYSIS OF COMMERCIAL FERTILIZERS USED ON 276 FARMS

	%	Farms	%	Farms	%	Farms
Nitrogen	0- 3	34%	3-4	57%	5-9	9%
Phosphoric Acid	0-10	34%	12-16	62%	16-40	4%
Potash	0- 3	5%	4-7	84%	7-12	11%

DIFFERENT ANALYSES OF COMMERCIAL FERTILIZER APPLIED - 64.

Broadcasting, before planting, was the method used in applying commercial fertilizer on 65% of 257 farms; in the row, before or at the time of planting, by 36%; top dressing alone after the crop was planted, by only 7%; and the remaining 5% used the broadcast and row method combined.

The preferred method of row application was in solid parallel bands along each side of the plant, two to three inches deep and about two inches from the plant. Top dressing, after the plants have been set, allows the plants full use only of nitrogen. In Pennsylvania soils, phosphoric acid and potash, applied as a top dressing after the crop has been started, do not reach the root zone of the plants in sufficient amounts to be of full benefit to the crop.

PLANTING

May 15 to 31 was the time when most ten-ton crops were planted, or 65% on 254 farms; and the next highest group was 19%, from June 1 to 5. On account of danger from frosts only 9% of the crops were planted before May 15; and to avoid low yields only 7% were set after June 5.

The amount of space allowed the plants was an average of 14 to 20 square feet, and more frequently 16 to 20, by 72% of 249 ten-ton growers; the other 28% being 10 to 13 square feet apart. Less injury to the vines resulted in picking between rows spaced about five feet apart, with usually three or more feet between the plants in the row. Wide rows, however, generally required the use of a single cultivator following the double cultivator in order to remove all weeds from the middle of the rows. Plants checked the same distance each way were easier to keep free of weeds on account of cultivating both ways in the field.

The average final stand of plants was 96% (245 farms) and 88% (255 farms) before replanting. Water was applied to the plants on 93% of 264 farms.

CULTIVATION

The number of cultivations given the tomato crop was four to five by 49% of 256 ten-ton growers, six to seven by 35%, and only two to three by the remaining 16%.

No hand weeding was done by 42% of these 256 growers; and 49% weeded only once. Only nine per cent gave two hand weedings.

HARVESTING

A comparison of paying the pickers by the day and by the basket was made on 104 farms in Lancaster County, where 24 growers were paid by the basket and 80 by the day. No difference could be seen in the quality of tomatoes, whether picked by the day or the basket. The rates of picking, however, were usually adjusted according to the condition of the crop - ranging mostly from three cents per basket in the peak of the season to five or six cents for the first and last parts of the season. Other growers paid rather high rates per basket through the entire season.

The largest yields per acre (14-20 tons) on 42 of 91 farms in Lancaster County resulted also in the highest quality (85 to 95% U.S. No. 1) on 52% from these high yielding crops.

YIELD IN RELATION TO QUALITY - LANCASTER COUNTY

Tons per acre	Av. Per Cent U.S. No. 1 70-79	80-84	85-95	Farms Number
10-13	12%	59%	29%	49
14-20	12%	36%	52%	42

High yields per acre, in addition to careful picking, are necessary to produce tomatoes of the best quality. Increased yields per acre result in lower costs per ton of tomatoes produced, and high quality is necessary for the best price per ton.

COST OF PRODUCING TOMATOES

Records of the cost of producing tomatoes were secured from 264 growers located in nine counties. These records were secured from growers who produced ten or more tons of tomatoes per acre and who grew at least two acres. The average acreage grown was 4.61 per farm.

The following factors were used in calculating the cost of production:

Man labor was charged at 25 cents per hour, horse labor at 15 cents per hour, and truck and tractor at 85 cents per hour.

Manure was charged to the crop at 75 cents per ton. Commercial fertilizer was all charged to the tomato crop.

Interest was charged at 5 per cent on the investment in land and equipment. The investment in general farm machinery used was prorated on the basis of total crop acreage in the farm. Ten per cent depreciation was charged on the investment in equipment.

The average investments per acre were $131.88 in land and $5.86 in equipment. This does not include the value of trucks and tractors since they were charged at the hourly rate.

The following table shows the man, horse, and truck and tractor hours used in the production of an acre of tomatoes and the cost of these operations calculated from the time required to perform them:

	Man Hours	Horse Hours	Tractor Hours	Cost
Growing plants	1.74	.06	-	$ .44
Hauling manure	6.80	13.56	.17	3.88
Hauling fertilizer	.22	.40	.03	.14
Plowing	4.02	7.66	.90	2.92
Discing	1.81	3.15	.81	1.62
Harrowing	1.45	3.51	.15	1.02
Rolling	.71	1.43	.01	.40
Dragging	.07	.10	.03	.05
Applying fertilizer	1.67	2.29	.10	.84
Planting	11.37	5.68	.16	3.83
Replanting	3.95	-	-	.99
Spraying, dusting	.83	.41	.02	.28
Cultivating	9.06	14.32	.59	4.92
Weeding	5.75	-	-	1.44
Picking	79.86	-	-	19.97
Hauling to market	14.38	.99	9.26	11.61
Labor of growing	47.71	52.51	2.97	22.33
Total labor	143.69	53.56	12.23	54.35

The total labor cost is $54.35 per acre, or 48.7 per cent of the total cost per acre. Picking requires more labor than any other operation. It represents 36.7 per cent of the labor cost by the farm help on the tomato crop and, in addition, $12.82 was spent for contract and day labor per acre. Hauling to market was the next most costly operation. It represents 21.3 per cent of the total labor charged and, in addition, $10.82 per acre was paid for hauling.

Cultivating and weeding accounts for 11.7 per cent of the labor cost. There was considerable variation in this cost. By cultivating at the proper time, four to five cultivations will produce the crop. Some growers found six or seven cultivations necessary and hoeing and weeding in addition.

The cost of planting and replanting was $4.82 per acre. The following table shows the labor requirements for planting by different methods used when all planting was done by one method:

		Planting				
Method	Acreage	Man Hours	Horse Hours	Truck and Tractor Hours	Replanting	Cost
Hand	139.12	18.50	-	.07*	2.65	$5.33
Transplanter Tractor	46.	6.73	-	1.91	2.02	3.83
Transplanter Horse	1,002.76	11.47	6.88	.06*	3.98	4.70

* Truck used to haul plants to field.

As will be seen from the table on Page 6, the cost of harvesting and marketing is about half the total cost of producing the crop. The labor of growing is 20 per cent of the total cost of the crop. Cost of plants vary greatly depending on the source of the plants. The plants for 161 acres were grown at home at an average labor cost of $1.88 per acre. The other growers purchased all or part of their plants for $8.35 per acre.

The following items were actual cash expense in producing the crop:

Cost of plants purchased--------	$ 7.06
Cost of spray materials---------	.85
Cost of fertilizer--------------	10.16
Picking hired-------------------	12.82
Hauling hired-------------------	10.82
	$ 41.71

Thus, 37.3 per cent of the total cost of producing the crop was actual cash expense, 48.7 per cent was labor cost, and 14 per cent was for overhead, manure, etc.

The following table gives the total costs involved in producing an acre of tomatoes in various sections of the state and for the state as a whole: (If data from your farm were included in this summary, the figures unler "Individual's Record" give your total costs.)

	Lancaster County	Bucks Delaware Chester Counties	Adams Cumberland Franklin York Counties	State	Individual's Record
Number of Records	186	54	22	264	
Fertilizer (lbs.)	553	953	553	701	
Manure (tons)	9.94	6.65	6.00	8.37	
Number of Acres	642.32	455.0	112	1,219.39	
Yield (tons)	12.72	12.44	11.13	12.45	
COSTS OF					
Plants	$ 6.44	$ 8.60	$ 8.72	$ 7.50	
Int., Dep., Tax	9.38	9.80	6.85	9.28	
Spray Materials	.06	2.20	.01	.85	
Fertilizer	8.14	13.69	7.63	10.16	
Manure	7.47	4.99	4.50	6.28	
Labor Growing	22.48	21.46	25.45	22.33	
Total Growing Costs	53.97	60.74	53.16	56.40	
Picking	33.71	33.08	27.17	32.79	
Marketing	21.56	26.83	10.55	22.43	
Total Harvesting Costs	55.27	59.91	37.72	55.22	
TOTAL COSTS	$109.24	$120.65	$ 90.88	$111.62	
Cost Per Ton	8.57	9.70	8.16	8.97	
Total Receipts	$172.17	$192.77	$149.13	$177.32	

These records indicate that tomatoes for canning purposes compare favorably with other farm enterprises where good cultural methods are used and good yields secured.

Soil - Clay loam; sod in 1934 and corn in 1935; plowed April 1, eight inches deep; disced once, harrowed six times and rolled seven times.

Fertilizer - 4-12-4 and 4-8-7, at the rate of 501 pounds per acre, in the row before planting with a potato planter.

Planting - May 15, with transplanter; water applied in the hill; 98% stand before, and 99½% stand after transplanting; plants spaced 5 by 4 feet apart.

Cultivation - Deeply at first, then shallow; cultivated 8 times double, 8 times single, and hand weeded once.

By Daniel H. Krieder

Variety - Marglobe.

Plants - Georgia certified.

Manure - Eight tons stable manure per acre.

Soil - Clay loam; sod in 1934 and corn in 1935; plowed in April, 7 inches deep; harrowed 4 times and disced 3 times.

Fertilizer - 4-12-4, applied at the rate of 700 pounds per acre, broadcast before planting.

Planting - June 12, with the transplanter, water applied in the hill; 95% stand before and 96% stand after transplanting; plants 5 by 2¼ feet apart.

Cultivation - Deeply at first, then shallow; 5 times double and twice single, not weeded by hand.

By A. G. Boley

Variety - Marglobe.

Plants - Georgia certified and in frames at home.

Manure - Twelve tons per acre.

Soil - Medium loam; sod in 1934 and corn in 1935; plowed in the spring; harrowed 4 times and rolled twice.

Fertilizer - 2-12-5, applied at the rate of 750 pounds per acre in the row before planting.

Planting - Middle of May with a transplanter; water applied in the hill; 85% stand before and 98% stand after replanting; plants spaced 39 by 37 inches apart.

Cultivation - Three times double and once single.

By Harry W. Huffnagle

Variety - Pritchard and Marglobe; seed purchased from F. H. Woodruff & Sons and treated with Semesan.

Plants - Grown at home in open beds by Walter Rush, under muslin frames, dusted three times with copper-lime dust.

Manure - Five tons per acre; or a light covering, of steer manure.

Soil - Medium loam, hay in 1934 and corn in 1935; about May 1, about 6 inches deep; disced twice, harrowed twice and rolled twice.

Fertilizer - 4-12-6, at the rate of 800 pounds per acre, applied broadcast before planting; top dressing of 150 pounds per acre.

Planting - June 2 - 5, with a transplanter, water applied in the hill; 98% stand before and 99½% after replanting; plants spaced 3½ by 3½ feet apart.

Cultivation - Deep followed by shallow, twice double and once single, no hand weeding.

Methods Used in Producing High Yields of Tomatoes

By Jonathan Zook

Variety - Marglobe and J.T.D.

Plants - Southern (Georgia) certified.

Manure - Twelve tons per acre, mixed.

Soil - Medium loam, tobacco in 1934 and wheat with sweet clover in 1935, plowed deeply on May 1 and disced once, harrowed 3 times and rolled 3 times.

Fertilizer - 8-24-16, 200 pounds per acre applied alongside the row after plowing.

Planting - May 25 with a transplanter and water was applied in the hill. The stand was 96% before and 99% after replanting. The spacing of plants was 4 by 3 feet.

Cultivation - Shallow at first, then deeply; 3 times double and 2 times with a single cultivator; and weed once.

By John W. Wolgemuth

Variety - Marglobe, Rutgers, and J.T.D.

Plants - Southern (Georgia) certified.

Manure - Twelve tons per acre, stable.

Soil - Medium loam; wheat in 1934 and alfalfa in 1935, plowed deeply in April; disced 3 times, harrowed twice and rolled once.

Fertilizer - 4-14-6, 250 pounds per acre applied broadcast before planting and harrowed deeply into the soil.

Planting - June 5 with transplanter and water was applied in the hill. Stand - 95% before and 99% after replanting. Plants were spaced 4 by 3 feet.

Cultivation - Shallow, excepting the first cultivation, four times double and hand weeded once.

By Tobias Z. Martin

Variety - Marglobe and J.T.D.

Plants - Georgia and Glick's, Lancaster County.

Manure - Fourteen tons of steer manure per acre.

Soil - Clay; grass in 1934 and corn in 1935; plowed 8 inches deep on April 15; disced 3 times, and harrowed twice.

Fertilizer - 3-12-5, 600 pounds per acre, applied in the row before planting.

Planting - Transplanter; water applied in the hill; 85% stand before and 98% after replanting, spaced 5 by 4 feet.

Cultivation - Deep; 3 times double, 2 times single and half hand weeded once.

By Enos L. Blank

Variety - Marglobe.

Plants - Georgia certified.

Manure - Plowed down seven tons and applied six tons on top.

Soil - Medium loam. Pasture in 1934 and corn in 1935; plowed deeply, April 15; disced once, harrowed three times, and rolled twice.

Fertilizer - 0-12-5, 600 pounds per acre, applied in the row before planting.

Planting - With a transplanter and water applied in the hill. The stand was 95% before and 98% after replanting. Plants were spaced 6 by 4 feet.

Cultivation - Deep, four times double, and weeded once by hand.

By M. D. Todd

The ground, on which I grew this crop, had been in corn the previous year and was well manured.

For the tomatoes, I put about 15 tons of barnyard manure to the acre, it was plowed down 8 inches in depth, as soon in the spring as I could work on the ground, two acres of this patch I covered with spent mushroom manure at the rate of about 15 tons to the acre.

This I disced and worked into the soil. I feel when it had the extra manure on top, it paid me well. I did not keep this part of the crop separate but I feel sure that they made at least one-third more tons to the acre. Also feel that it will pay any one growing tomatoes, to top dress the plowed ground and disc it in.

I used Baugh's fertilizer 2-8-10 and disced the ground just as fine and deep as I could possibly work it, then marked the rows four feet each way, planted all by hand, which were planted in dry weather, and watered ahead of the planting. They were planted in a few days by working at them in the afternoons.

I worked the plants with a double cultivator both ways, just as soon as they stood up, but kept far enough away so as not to loosen the plants.

I cultivated them fairly deep and continued cultivating as I thought they needed. During each working I kept farther away and did not cultivate at any time when the ground was wet or where vines were damp, the last working very shallow with a single harrow just enough to stir up top of ground, after that I could not get thru them.

This variety was Stone tomato which I planted about 20th to 25th of May and would say I had at least a 95% stand.

Possible Readjustments in the Fruit and Vegetable Markets of Philadelphia

R. B. Donaldson, State College, Pa.

Today I should like to present to you some possible readjustments in the fruit and vegetable markets of Philadelphia, the result of a coöperative study conducted by the Pennsylvania State College in conjunction with the New Jersey Agricultural College and the U. S. Bureau of Agricultural Economics. The results of this study indicate the outstanding need for a consolidation of all wholesale produce markets in the city of Philadelphia. Such a consolidation is necessary before such problems as unregulated selling hours, unethical trade practices, and congestion can be intelligently solved.

There are five wholesale markets in Philadelphia, other than chain store warehouses, which are important in the handling of fresh fruits and vegetables. These markets consist of the Dock Street market, the Callowhill Street market, the Pennsylvania Railroad Produce Terminal, the Baltimore and Ohio-Reading Produce Terminal, and the river front piers.

The situation in Philadelphia is that there are excess facilities in some markets, with inadequate facilities in others. This is due partly to the over-expansion of the railroad terminal markets, but for the most part it is due to a shift in the type of business transacted on these markets. For several years rail receipts have been declining, while motor truck receipts, especially from distant points, have increased. This indicates that the trend is definitely toward more and more motor truck receipts. Philadelphia, although having more than ample facilities for handling rail receipts, has no facilities for handling any large quantities of produce received by truck.

One of the greatest objections to the present situation in Philadelphia from the point of view of the large buyer is the fact that it is a split market - that is, buyers must patronize more than one market in order to obtain their supplies. This situation is made more difficult and expensive by the lack of correlation among the hours of selling at the various markets.

Sales of fruits and vegetables in wholesale quantities, therefore, should be consolidated into one location. Then large buyers would not find it necessary to visit several markets to obtain their supplies, and wholesalers in Philadelphia would not be forced to operate in more than one market.

Such a consolidation of markets could be accomplished in several ways. As far as location is concerned there are two general possibilities; that is, the consolidated market might be organized either (1) near the present jobbing markets at Dock Street or Callowhill Street, or (2) near the railroad terminals.

A location near the present Dock or Callowhill Street markets would have two advantages. First, the wholesale fruit and vegetable markets have been located in these areas for several generations, and, second, the location would be slightly more convenient for some local farmers and Philadelphia retailers than the location near the railroad terminals. The main disadvantage of the Dock Street or Callowhill Street location would be that the construction of a modern, consolidated market in either of these locations would require extensive renovation and expansion and would probably cost much more than a consolidated market near the railroad terminals.

There would be several possible ways of organizing a consolidated wholesale market at or near the railroad terminals. Such a consolidation should provide for the handling of at least enough truck receipts to give both quantity and variety sufficient to meet the needs of large out-of-town and chain store buyers. This would avoid a split market for large buyers and at the same time would relieve congestion on the Dock and Callowhill Street markets. This would tend to centralize wholesaling at the terminals and leave most of the jobbing on the Dock and Callowhill Street markets. Motor truck receipts at the terminal might be handled in several ways. They might be handled in the railroad terminals on the same trading floor or on an adjoining platform on the same basis as the rail receipts.

If, on the other hand, individual stores are preferred for handling these truck receipts at or near the railroad terminals, there are at least three possibilities worthy of consideration. First, the Pennsylvania Produce Terminal has a building that could be divided by partition walls and rented to the wholesale trade, and land is available upon which other stores could be erected when needed. Second, there is vacant land near the Pennsylvania Produce Terminal upon which the necessary stores could be built in such a way as to constitute a well-arranged market. Finally, there is a possibility of converting the unused facilities of the Baltimore and Ohio-Reading Produce Terminal into a modern truck market. The first two of these possibilities would accomplish a greater degree of consolidation than would the last one.

If wholesaling of both rail and truck receipts is to be consolidated in the Dock Street area, considerable expansion, renovation, and some rebuilding would be necessary immediately. Even if the wholesaling is consolidated at or near the railroad terminals, however, there should be some improvement in the Dock Street market to make it a good modern jobbing market, but in this event the improvement in the Dock Street facilities should be based upon a careful consideration of the readjustments which would result from the development at or near the terminals. In any case, immediate steps should be taken both in the Dock Street and in the Callowhill Street market to improve traffic regulation, sanitary conditions, and hour regulation.

Rapid Fertility Tests for Vegetable Soils

Jackson B. Hester
Virginia Truck Experiment Station
Norfolk, Virginia

Soil fertility is a result of many chemical factors. Vegetable crops are sensitive to soil conditions. Therefore, reliable soil tests that give an indication of these conditions in the soil are valuable in vegetable crop production. Many vegetables are sensitive to acid conditions in the soil and the pH value gives an indication of the degree of acidity. From this information the soil may be brought to a state more favorable for crop production. Soils that grow vegetable crops must be well supplied with organic matter. When the organic matter content of the soils drops below a certain point the production becomes unprofitable. This condition may be indicated by the soil chemical tests.

A test for toxic aluminum is valuable for crops that require extremely acid soil conditions for control of certain diseases. When aluminum appears in the soil solution in sufficient concentration to prove toxic to crops, the acidity cannot be permitted to increase without economic loss.

Many soils have a strong power for fixing phosphorus in a state unavailable to crops. It is important to get an indication of the available phosphorus in the soil to fertilize the crop economically.

Soil conditions influence the availability of phosphorus and fertility tests are important to show these conditions. Fertilizer plats in the field have shown that crops do not respond to applied phosphorus, where the soil is well supplied with that nutrient, but give a very large increase in yield where the supply is low.

Potash is an important nutritional element for vegetable production. When it is present in abundant quantities in the soil, however, additional amounts do not increase the yield. Soil tests, as compared with fertilizer applications in the field, have shown where potash fertilization was advantageous.

In short, fertility tests when properly conducted and correlated to local soil conditions are a valuable aid in growing vegetable crops. The tests, however, require certain technical skill and may be very misleading unless properly made and interpreted.

Recent Developments in Fertilizers and Their Uses

F. G. Merkle
Pennsylvania State College

Changes are constantly taking place in the manufacture and use of commercial fertilizers. Many of the problems and controversies of 3 decades ago have been solved and ironed out as a result of the splendid cooperation between the manufacturers, research workers and the growers. I have been assigned the task of calling to your attention the newer developments in the manufacture and use of fertilizers. I shall discuss this topic under the following headings:

I. Acid vs. Neutral Fertilizers.

II. Granular vs. Powdery Fertilizers.

III. Concentrated vs. Ordinary Fertilizers.

IV. Need of the Less Common Elements.

V. Methods of Application.

I. Acid vs. Neutral Fertilizers

It has been known for a long time that certain ingredients commonly used in fertilizers have the effect of making the soil acid while others tend to leave it basic while still others have little or no effect. This tendency has been called physiological acidity or basicity because the material in itself may be neutral and still have an acid reaction upon the soil. The effect in the soil is like that of certain foods that we eat which are neutral in themselves but which on digestion produce acidity or basicity.

Pierre has developed a laboratory method by which we may determine the degree of acidity or basicity a fertilizer possesses. It consists of burning the organic matter from a sample and determining chemically whether the ash contains more acids than bases or vice versa. The nitrogen which is volatilized on burning is determin on another sample and due consideration given to its acidifying action. The method, though not perfect, has made it possible to say whether a given raw material or mixed fertilizer will increase or decrease the acidity of the soil. Table I shows the approximate amount of ground limestone needed to neutralize the acidity produced by a ton of the well known fertilizer as well as the limestone equivalent of those which have alkaline reaction on the soil.

Table I. Equivalent Acidity or Basicity of Common Raw Materials (Pierre) in Pounds of $CaCO_3$ (Ground Limestone) per Acre

	Equivalent Acidity		$CaCO_3$ Basicity
Superphosphate 17-20%	17	to	62
Steamed Bone			1214
Bone Ash			1413
Limed Superphosphate			423
Texas Bone			852
Precipitated Bone			586
Texas Brown Rock			1122
Sulphate of Ammonia	2249		
Ammonian Chloride	2786		
Mono Ammonium Phos	1292		
Ammo - Phos	1997		
Urea	1680		
Nitrate of Soda			583
Cal-Nitro			346
Calcium Cyanamid			1245
Animal tankage	29		
Highgrade tankage	122		
Low grade tankage			144
Fish scrap	169-227		
Cotton Seed Meal	190		
Tobacco Stems			80-356
Guano	269-274		
Dried Blood	451-463		
Milorganite	238		

This table shows that in general the phosphatic fertilizers have either no effect or tend toward leaving the soil more basic. Even superphosphate, formerly called acid phosphate has little or no effect upon the soil reaction. The raw and steamed bones and rock phosphate tend to leave the soil basic.

Those nitrogen carriers which contain their nitrogen as ammonia or in organic form leave the soil acid. The ammonium salts and urea would require approximately a pound of limestone to neutralize the acidity produced by a pound of the fertilizer. Calcium nitrate, cal-nitro, and nitrate of soda leave the soil more basic. The potash salts are not reported in this table but it is well known that they have little or no effects upon soil reaction.

These laboratory determinations of physiological acidity or basicity of fertilizers are substantiated to a large degree by field experiments. The writer has measured the effects of 50 years of fertilizing with numerous materials on the reaction and active base content of the Jordan Plots at the Pennsylvania Experiment Station and has found that the various materials act in the way indicated by the laboratory methods of Pierre.

Perhaps the greatest change that has taken place in the fertilizer industry or the last twenty years is thegradual replacement of nitrate of soda or organic carriers by ammonia forms of nitrogen. This is due to the fact that the ammonia form is cheaper. Thus a complete fertilizer may contain 200 to 600 pounds of sulfate of ammonia which would require the use of an equal amount of ground limestone to neutralize the physiological acidity produced by the nitrogen alone. Manufacturers, acting upon the suggestion of research workers, are now adding sufficient limestone to some of these mixtures to neutralize the physiological acidity anticipated. This limestone takes the place of the filler or conditioner formerly used. Dolomitic limestone, which contains calcium and magnesium carbonates, is preferred to calcium limestone since the former has little or no tendency to render the phosphorus in the mixture unavailable. In addition it provides magnesium in readily available form. The dolomite for this purpose should be finely ground, that is it should go through a 100-mesh screen, to be effective in neutralizing and to furnish available magnesium.

What is the place of neutral vs. acid fertilizers in Pennsylvania agriculture and horticulture? Both are on the market and the difference in cost is small. Fertilizer trials in pot experiments and field experiments conducted on sandy soils of the coastal plains have shown that the neutral mixtures nearly always give significatly larger yields than the acid mixtures! They also show that the acid mixtures rapidly lower the pH value of the soils. On the heavier soils of Pennsylvania we need not look for such remarkable differences. Our soils are richer in clay and humus and will not be made more acid so easily as the coastal plain soils. B. E. Brown reports the results of using acid fertilizers in comparison with neutral mixtures of the same plant food contents on cooperative potato experiments at New Jersey, Maine and Virginia as follows:

Table II Acid vs. Neutral Fertilizer for Potatoes in Maine. (Soil Acid)

	Reaction of Mixture: Acid	Neutral
Yield	495 bu.	485 bu.
	496 "	481 "
	479 "	494 "
	493 "	479 "
		490 "
		508 "

Table III. Acid vs. Neutral Fertilizer for Potatoes in New Jersey. Three Farms, pH 4.6 - 5.2 (Soil acid)

	Reaction of Mixture Acid	Reaction of Mixture Neutral
Yield	174 bu.	174 bu.
	182 "	184 "
	191 "	180 "
	177 "	182 "
		180 "

Table IV. Acid vs. Neutral Mixture for Potatoes in Virginia, 2 Farms, pH 5.3 - 5.4 (Soil acid)

	Reaction of Mixture Acid	Reaction of Mixture Neutral
Yield	213 bu.	206 bu.
	213 "	205 "
	219 "	213 "
	202 "	213 "
		212 "
		218 "
		211 "
		212 "

In these experiments reported in Tables 2, 3 and 4, there is little preference of one form over the other. They are in contrast with the results obtained at West Virginia and other Coastal Plain Stations on vegetable crops, where much better germination and growth was obtained with neutral mixtures.

The use of neutral mixtures is to be recommended but we should not rely on them to correct acid soil conditions. The small amount of dolomite contained in a fair acre application of fertilizer will be totally inadequate in changing the reaction of an acid soil. It may simply be expected to prevent an increase in acidity. A 1500 pound application of a neutral mixture might contain 150 to 250 pounds of dolomite, an amount which might influence a sandy soil but have little or no effect upon a heavy one.

II. Granular vs. Powdery Fertilizers

Recently some manufactures of superphosphate, cyanamid, and some synthetic fertilizers have put out their products in pellet or granule form. This has been done to produce a product which will not cake badly in storage, which will flow readily thru distributors without arching and which might be broadcast with knapsack grain seeders. These aims have been realized but what of the availability of large pellets as compared with powdery products?

Table V. Comparison of Granulated vs. Powdered Fertilizers on Corn in Pot Experiment.

	Mixed with Soil	In Layers
14-42-14 Granulated	241	299
14-42-14 Powdery	172	347

Mack at the Pennsylvania Experiment Station obtained better results with the powdery product on spinach. Conner obtained the reverse, Table V. Sayre conducted a rather detailed trial with these two products on tomatoes and obtained distinctly better results with the granular form. Table VI.

Table VI. Comparison of Powdered vs. Granulated 4-16-4 for Tomatoes:

	Yield per Acre No Fert.	Broadcast Powder	Broadcast Gran.	Tons In Bands Powder	In Bands Gran.
To Aug. 31	0.74	1.1	1.29	1.33	1.49
" Sept.10	1.62	2.53	3.15	3.08	3.53
" Sept.30	6.62	8.52	9.51	8.88	9.65
Gain due Fert.		1.90	2.89	2.26	3.03

It is believed that less fixation of available phosphate can take place from the pellets than from the powder. Sayre proved this to be the case by analyzing some of the pellets remaining in the soil 16 weeks and found that 95% of the N and 85% of the K_2O had dissolved from the granules while much of the available phosphate remained within. Further studies must be conducted along this line but both theory and trial seem to concur that the pellet form is here to stay.

III. Concentrated vs. Ordinary Fertilizers.

The low analysis fertilizer of 10-20 years has nearly disappeared from the market. This is the result of consistent fighting on the part of teachers of agriculture and efforts of the National Fertilizer Association. What was formerly the high analysis mix is now the ordinary fertilizer. Recently concentrated fertilizers compounded from synthetic nitrogen materials have appeared. Such may contain 30, 40, 50 or even 60% total plant food. The following questions concerning their use have arisen.

a. Comparative costs.

b. Effect on germination and growth.

c. Absence of other elements.

The chief difference in cost is that resulting from a saving in freight. Containing, as they do, two or three times as much plant food as ordinary fertilizers there is some saving in freight, cartage, and handling.

Table VII. Comparative Costs of One Unit of Plant Food in Low and Higher Analysis Fertilizer Delivered to the Farm. Ratio in all Cases 1-2-1.

	N.Y. & W.Pa.	No. Carolina	Ind.
4-8-4	1.85	1.80	1.94
5-10-5	1.68	1.65	1.90
6-12-6	1.53	1.55	1.70
8-16-8	1.47	1.43	1.67
10-20-10	1.43	1.35	1.62

Concentrated fertilizers are composed of highly soluble salts, hence the question as to the effect of these upon germinating and growth as a result of over concentration of the soil solution. Doubtless this question arose as a result of some person using the concentrate form at the same rate as he formerly used the ordinary form. Numerous experimental trials in which equivalent amounts are used indicates that the concentrated forms are as good as the ordinary and that they do not over-concentrates the soil solution.

B. E. Brown and C. A. Cummings obtained the following results with potatoes in Maine, New Jersey and Virginia. Table VIII.

Table VIII. Potato Yields from Fertilizer. Placement 2 inches from Seed Piece on Same Level.

	Maine Caribou Loam		New Jersey Sassafras		Virginia Sandy Loam	
	4-8-7	8-16-24	4-8-7	8-16-14	6-6-5	12-12-10
1932	312	313	252	254	123	112
1933	300	316	236	240	219	232

These results are typical of many other experiments which testify that high analysis fertilizers if used in comparable amounts are as effective as ordinary mixtures and no more injurious to germination.

Concentrated fertilizers contain less calcium, magnesium, sulfur, and probably also less of the minor elements than the usual ordinary mixture. The reasons for this are obvious. They are prepared from atmospheric nitrogen in most instances and are so compounded that the nutrient bases are combined with the nutrient acids thus precluding the presence of calcium, sulfur, and magnesium. Whether or not the absence of these elements is compensated for by their lower net cost cannot be determined at this time.

IV. Need of the Less Common Elements.

The complete fertilizer of the past has been purchased for its nitrogen, phosphorus, and potassium, but it invariably contained calcium and sulfur. Therefore the two latter elements were cared for quite well. This brings up the question as to whether the continued use of the so-called high analysis brands which may contain little or no calcium or sulfur may not eventually lead to a depletion of these elements. Sulfur is added to the soil annually through rains in amounts greater than required by plants. Calcium needs should be taken care of by liming to bring the reaction of the soil up to somewhere around pH 6 or 7 depending upon the crop grown. The so called exchange complex of the soil should be around 3/4 saturated with calcium and liming is the cheapest and best way to do this.

Magnesium is next in importance. It is required by plants in considerable amounts. It is a constituent of chlorophyll, the green pigment so important in photosynthesis. It is most significant for leafy plants and those producing quantities of starch or sugar in the storage organs. When magnesium is deficient for normal plant functions the lower leaves become yellowish. The yellowing begins at the tips and margins of the leaves and spreads between the veins causing a bulging of the tissue between the veins. Upper leaves are affected later. Toward the last stages the tissue becomes brittle.

Like calcium, magnesium is leached from soils as a result of cultivation and exposure to fall and winter rains. The sandy soils of the Atlantic Coastal Plains and the heavily cropped Maine potato soils have already shown unmistakable deficiency of magnesium which cannot be replaced by other elements. Good increases in yield, vigor, and color have been obtained by the use of magnesium sulfate, dolomite, kieserite, or sulfate of magnesia, added to the fertilizers for such soils.

The soils farther inland and this includes most of Pennsylvania, contains more clay and are not so deficient in magnesium, nevertheless those types which are most acid are most likely to be deficient in this element. The chemical tests for available magnesium are not very reliable but they give us a general idea of the probable status of this element.

The use of neutral fertilizers which have their physiological acidity cared for by the addition of dolomite (magnesium limestone) will take care of any possible magnesium deficiency. Farm manures, particularly urine, contain considerable magnesium. Many gardeners have been forced to replace animal manures with fertilizers. These will be the first to suffer from the lack of this element.

Time will not permit us to take up a complete discussion of the significance of the minor elements, copper, maganese, boron, zinc, cobalt, and host of others. Attention has been attracted to these as a result of water culture studies and fertilization of extreme soil types. It can be proven that each of these elements is needed in very small amounts in plant nutrition but the amount must be very small. Several of the above are toxic even at low concentrations. Some peat and muck soils which are chiefly composed of leached vegetable tissue are benefitted by application of copper, maganese, and sometimes other elements. These two circumstances, together with the advertising claims of a few fertilizer companies, have given rise to an undue interest in the so called rare or minor elements. In Pennsylvania our muck areas may require such additions but in the present state of our knowledge it seems that the traces required are present in nearly all of our soils.

It should be mentioned that the solubility of manganese is determined by the soil reaction. In over-limed soils with high pH values pH 8. - 8.5, manganese and iron may become so insoluble that plants growing on such soils become chlorotic.

If attention is given to maintaining a supply of activity decomposing organic matter by means of manure, green manure or sod crops the whole question of minor elements will be dispensed with.

V. Method of Application

Considerable information has been gained with reference to the manner of application of fertilizers. Germination, root growth, and yield may be considerably decreased if fertilizers are used in close contact with the seeds. The effectiveness of the fertilizers on the other hand, may be decreased by adsorption and fixation if they are mixed intimately into the soil as in broadcast applications.

At one time it was customary to place the fertilizer in the drill and plant the seeds or tubers in direct contact with it. Others advocated mixing the fertilizer in the drill and planting seeds or tubers in the well mixed soil. Neither is a good practice for these reasons. Those fertilizers which are soluble salts produce a somewhat concentrated solution preventing the seed from taking up the moisture it needs to germinate. Hence germination may be prevented or considerably delayed. Seeds will germinate better in fresh moist sand than in soil, showing that nutriment is not required for the process. The organic fertilizers like dried blood, dried fish, cotton seed meal, and even animal manures favor a rapid growth of molds which attack the sprouting seeds. Hence nearly all the nitrogen carries and potash salts hinder rather than assist germination.

The phosphates produce the least injury. This is because of their low solubility and the fact that the phosphate which goes into solution is generally fixed by the soil.

Table IX. The Effect of Fertilizers upon the Germination or Sprouting Showing the Proportion Germinating.

Material	Clover 20 Seeds	Corn 5 Seeds	Soybeans 5 Seeds	Potato 1 Tuber
Nitrate of Soda	0	0	0	0
Sulfate of Am.	0	0	0	0
Ammo. Phos	2 Weak	0	0	0
Cyanamid	0	0	0	0
Superphos	15	5	5	0 started
Dis Bone	7	5	1	0
Fish	9			
Blood	13	5	0	0
Slag	11	5	4	started
St. Bone	13			0 "
Muriate of Pot.	0	0	0	0
Sul. of Pot.	1	0	0	0
Sulf. of Pot. L G	1	0	0	0
No Fert.	13	5 good	5	sprouted

Nearly all trials indicates that the seed or tubers should not be placed in contact with the fertilizers. Place it in fresh soil. It is true that small grains are dropped in close contact with the fertilizer but the amount used is small and is composed chiefly of phosphates which are the least injurious materials.

Broadcast application also is to be avoided except where absolutely necessary. It is believed that thorough mixing of fertilizers so that they come in intimate contact with all the soil particles increases the chances for fixation of phosphorus in particular and this results in poorer yields.

The most promising method of application, if the character of the crop will permit it is to have the fertilizers placed in bands nearly on a level with the seed or tubers and about two inches on each side, thus permitting the seed to be in fresh soil, and still keep the fertilizers from being fixed by the soil.

Table X. Placement Tests With Fertilizers For Potatoes. B. E. Brown. Average of Several Years Work in Maine, Mich. 2, N. J., N.Y., Ohio, Va.

In furrow well mixed in soil	240 bu.
Side placement, bands 2" from seed on level with seed	289 "
Bands 2" on side and 2" below seed pieces	265 "
4" on side in bands and on level with piece	282 "
1" on side in bands and on level with piece	279 "
4 - 5" band 1" of fertilizer free soil between seed and fertilizer	258 "

Spinach Varieties for Market

W. A. Frazier

In discussing these varieties, you must realize that our work has been done in the Baltimore area of Maryland, and the performance of the various varieties may not be relatively the same in your locality. It would seem, however, that the two regions are near enough alike so that spinach will, in the main, react similarly.

Since the savoyed varieties are most desirable for market because they hold up better in the basket and keep a better appearance on the retail stand, we shall discuss them first.

Virginia Savoy or Blight Resistant has been successfully grown in Maryland for several years. In our tests it has yielded well for the fall crop, and is recommended for fall planting, but never for spring planting, since it goes to seed so early. It is blight resistant and exceptionally winter hardy.

The Old Dominion variety is somewhat similar in appearance to Virginia Savoy, and is recommended for fall planting. Yields have been slightly below Virginia Savoy in fall plantings. It will not go to seed quite so early in the spring, however. It is winter hardy and can be planted for over-wintering.

Reselected Bloomsdale and Dark Green Bloomsdale have, in our trials, been very similar in growth characteristics. They are highly recommended for spring planting for the market. They are not winter hardy.

Longstanding Bloomsdale is a slow growing, savoyed variety, desirable where the grower wishes a part of his acreage held past the usual spring harvest date for Reselected or Dark Green Bloomsdale.

Longstanding Bloomsdale may stand from 5 to 10 days longer than these varieties before going to seed, and in rich soils this variety will give a satisfactory yield.

The above mentioned varieties, all savoy types, are recommended in Maryland for market purposes, although for canning and for highest yields some of the new, dark strains of flat leaved spinach are most desirable. Two of these, Hollandia and Giant Leaved Gaudry are fast-growing, large leaved varieties, yielding heavily both in fall and spring, and go to seed about the same time as Long Standing Bloomsdale or possibly a little earlier. The home gardener should try these varieties.

Strains of vegetable crops are sometimes as important to know as varieties. It is wise for the vegetable growers - especially spinach growers - to inquire of your state experiment station for definite recommendations regarding the performance of strains.

Sweet Corn Varieties and Their Improvement

Donald F. Jones
Connecticut Agricultural Experiment Station, New Haven, Conn.

Hybrid sweet corn is listed in many seed catalogs. Larger acreages are being planted each year. This growing interest places this new kind of seed in a rather critical position. Seedsmen with little previous experience are rushing into the production of this cross bred seed corn that everybody wants and is willing to pay high prices for. Many new combinations are being put out each year. Some of these have not been adequately tested. This means that there are going to be many failures and disappointments. Growers should remember that hybrid corn is no better than the seedsman that produces it. Go slow with hybrid corn until you have given it a careful test and have located a reliable source of seed.

Since hybrid corn is more uniform it must be more thoroughly adapted to the section where it is to be grown than naturally-pollinated varieties. In general it has been found that varieties and hybrids developed in the northeastern section where the average corn yields are high cannot be grown so successfully outside this region as varieties that have been developed under less favorable growing conditions. For productive types Pennsylvania should develop its own varieties and hybrids or look to adjacent regions to the south and west. For early corn the adjacent regions to the north are most likely to give the best results. It makes no difference where the seed is produced so long as it is kept adapted to the locality where it is to be grown by having the stock seed selected and grown there.

The following hybrids have all been tested and are known to do well in the northeastern states:

Early

Marcross C6
Marcross C13.6
Marcross C3
Gemcross P39
Spancross C2

Second Early

Spancross P39
Marcross P39
Early Bancross P39
Seneca Golden

Yellow Mid-season

Whipcross C6.2
Whipcross P39
Whipcross P39.C2
Golden Cross Bantam
Bloomcross P39

White Mid-season

Pearlcross
Redgreen

A Trial of Varieties of Celery for the Philadelphia Market

John A. Andrew, Jr.
School of Horticulture, Ambler, Pa.

This experiment was conducted in cooperation with the Pennsylvania Agricultural Extension Service in order to determine the varieties and strains of celery most suitable for the southeastern part of the State. The seed, which consisted of eight strains of Golden Plume and seven of Easy Blanching and Full Heart types, was supplied by Prof. J. M. Huffington.

I think it best to give you a general idea of the methods used to grow these varieties before proceeding further as undoubtedly they are of prime importance in the results obtained.

Seed Treatment:

The seed of every strain was treated with calomel to prevent damping off. The seed of each strain was placed in a cheesecloth bag which was suspended in a solution of one ounce of calomel in a gallon of water for three minutes. The seed was spread out, allowed to dry, and put back in the package to be planted later. Not one plant was lost by damping off.

Sowing Seed:

The seed was sown on April 6 in a cold frame. The soil was firmed, watered, the seed broadcast and covered with finely sieved sand. It was not necessary to apply additional water until the seedlings were above ground.

General Care Before Transplanting:

As soon as the first true leaves appeared the plants were dusted with a copper-lime mixture. The plants were dusted regularly and only minute traces of blight were observed in 2 cases.

The plants were not transplanted before being set in the field but in some cases it was necessary to do a little thinning out.

The plants were thoroughly soaked and sprayed before they were set out.

Soil Preparation:

The soil was tested and sufficient lime applied to bring it up to neutral. A liberal application of well rotted cow manure was plowed under and a 5-10-5 fertilizer applied at the rate of one pound to 50 square feet and raked in before planting. The soil was a silt loam.

Setting out Plants:

The plants were set out on July 3, six inches in the row and four feet between the rows. Fifty plants of each strain were set out.

The plants received no water from any artificial source after being set out except that from sprays which were consistently applied every 10-14 days until September 20.

As no appreciable amount of rain fell for three weeks the plants were mulched with hay. This mulch remained there until September 20, so that the plants thrived without any cultivation and an occasional weeding.

On September 22 the plants received an application of nitrate of soda at the rate of 200 pounds per acre and on October 1 paper was put on to bleach them.

On October 16 Prof. J. M. Huffington, C. K. Hallowell and a representative of Eastern States Farmers Exchange made the following observations which are recorded in order.

1. Golden Plume (Jersey Strain - Eastern States Farmers' Exchange)
   Height - 26", stalks - 9½", circumference 8"
   Very good strain; Ribs broad and medium deep
   Heart medium height; Medium heavy - 7 stalks per plant

2. Golden Plume (Abbott & Cobb)
   Height - 27", stalks - 11", circumference 7"
   Not quite so good here as Golden Plume (Jersey-E.S.)
   Stalks too slender and tapering, shank (top) too long
   Ribs narrow and medium deep
   Medium full heart
   Medium weight - 7 stalks per plant

3. Golden Plume 4162 (Ferry-Morse)
   Height - 26½", stalks - 9", circumference 7½"
   Rather uneven
   Good heart
   Some plants of excellent type, others with stalks tapering to a small size at the top.

4. Golden Plume - Jersey H63-17 (Forbes)
   Height - 24", stalks - 9", circumference - 6"
   Too light all through. Tall and thin.

5. Golden Plume Hybrid No. 8 (Ferry-Morse)
   Height - 22", stalks - 7½", circumference - 7½"
   Full tall heart
   Good type
   Rather small here
   Shows good promise

6. Golden Plume #36 (Ferry-Morse)
   Height - 25", stalks - 9", circumference 6½"
   Ribs medium in width and depth
   Tall heart but rather light
   Stalks of good size

7. Golden Plume - Cal. (Eastern States)
   Height - 20", stalks - 7", circumference - 7½"
   Good type but rather small here.

8. Michigan Golden (Mich. State College)
   Height - 23½", stalks - 8", circumference 7¼"
   Uneven; light - poor for crates
   Bushy top

Easy Blanching and Full Heart Types

1. Gilt Edge Easy Blanching - 1117 (Tether)
   Height - 26½", stalks - 10½", circumference 8¼"
   Good length of stalks, thin at base
   Tall full heart
   Stalks more tapering than Full Heart (Forbes)

2. Full Heart 1158-12 (Forbes)
   Height - 23", stalks - 8", circumference 8¾"
   Best short stemmed celery
   On poorer soil the hearts may be too short

3. Sweet Heart Easy Blanching (Abbott & Cobb)
   Height - 22½", stalks 7", circumference - 10"
   Broad ribs - rather smooth stalks
   Similar to Full Heart (Forbes)

4. Full Heart East Blanching (Abbott & Cobb)
   Height - 22½", stalks - 7", circumference - 9" and 25 - 9 - 8
   Early - brittle
   Good celery but not uniform - short to tall

5. Easy Blanching (Ferry-Morse)
   Height - 23", stalks - 9", circumference 6¾"
   Only fair - tapering stalks

6. Green Hybrid No. 6 (Ferry-Morse)
   Height - 23½", stalks - 8", circumference 7¾"
   Best new celery
   Quite uniform
   Dark green
   Medium stalks

7. Newark Market - 1183 (Tether)
   Height - 24", stalks 8½", circumference 7¾"
   Old type for S. E. Penna. section
   Dark green, round stalks
   Similar to Ferry-Morse's Easy Blanching except short stalks

Tomato Quality Studies in Maryland

W. A. Frazier
University of Maryland

It is important to bear in mind the fact that every operation in the production, picking, and handling of tomatoes will in some degree influence tomato quality. Therefore, the following suggestions are offered with regard to production and handling of canning crop tomatoes for high quality:

I. Production Factors

A. Soil nutrients. The tomato is one of the most responsive of all vegetable crops to plentiful fertilization. It responds especially to barnyard manure, and phosphorus applications. In Maryland 4-12-8, and 4-8-5 are most often used. The Pennsylvania grower should consult his Experiment Station with regard to the formula to use. Rotation is necessary for successful continued tomato production.

B. Seed and plants. Seed should be purchased from reliable seedsmen. Stocky plants result from proper seed bed care. If Georgia plants are purchased they should be planted soon after arrival. If plants are grown in coldframes do not plant seed too thickly.

C. Variety. For canning crop tomatoes, Marglobe, Greater Baltimore, Rutgers, and Pritchard are generally superior at this time, both for Maryland and Pennsylvania.

D. Planting and cultivation. In Maryland the earliest plantings (but late enough to avoid frost) give higher yields, and only shallow cultivation is made after plants have begun growing well. Deep cultivation after this time will injure the roots and reduce yield, as well as foliage.

E. Picking and handling. For canning purposes, careful picking is extremely important. Pickers should be warned not to pick partially green fruits. Canners make a mistake in letting tomatoes sit in baskets for several days before they are canned. In rush seasons it is difficult to avoid this situation, but it should be remembered that losses from rots and insect infection become steadily higher in such fruits.

II. Factors More Directly Concerned with Fruit Quality

A. Color. Deep red color is essential to high quality in tomatoes. We have found that within our major varieties, there is no appreciable difference in color. The most important thing is heavy foliage, which prevents sun from shining on fruits and raising the temperature. If the temperature of the fruit rises above 90°F, color development stops. Excellent color will develop in total darkness.

B. Chemical composition. The relative amounts of chemical constituents in the fruit will affect taste. Sugar content and acidity are important. Fruits become less acid as they ripen, and increase in simple sugars. When fruits are allowed to ripen on the vine, sugar content will increase somewhat, although ripening will continue in a normal way when fruits are allowed to ripen off the vine. Water content of the tomato ranges generally from 93 to 95%, depending upon the amount of rainfall during the season.

C. Taste. Varies with individuals, a minority of whom prefer more acid fruits. Some of the variation in acidity of fruits is caused by the different amount of wall tissue in tomatoes. The locular contents (the watery material in the fruit cavities) is more acid than the solid wall tissue. Thickness of wall varies with season, being thicker early in the season, and generally thicker when the vine receives a plentiful nutrient and moisture supply.

D. Freedom from Blemishes. From the grading standpoint, it has been found in Maryland that as a rule the most frequent causes for culls are: rots, cracks, sunburn, and misshapen fruits. Losses from rots can be decreased by picking more often. Cracking losses will be reduced when vines have heavy foliage, uniform moisture supply, and fruits are picked as soon as possible. Good foliage also reduces sunburn losses.

It is readily apparent that many of these factors concerned with fruit quality are dependent upon methods of growing. It is apparent, further, that in our section, good foliage is highly correlated with high quality and high yield.

Variety Trials of Tomatoes, Sweet Corn, and Peas in 1936

Warren B. Mack
State College, Pa.

In this discussion, which constitutes part of a half-day program for growers of canning crops, particular attention should be paid to the varieties which are suited for canning, though some mention will be given to market varieties.

Marglobe, Rutgers, and Baltimore are varieties which because of yield, firmness, color, and uniformity are leaders in the canning tomato group; the first two are more desirable in shape for market purposes than is the last. Bonny Best is preferable to the above varieties for market or canning in the parts of the state in which the growing season is relatively short. Each variety mentioned has its advantages and disadvantages: Bonny Best, for example, is well colored and is less subject to fruit cracking, but is more subject to foliage diseases and is less firm than are the others named. Marglobe is subject to cracking, but is desirable in other characteristics. Rutgers is a little less subject to cracking and under commercial conditions develops a little higher flesh color than does Marglobe, and is little subject to foliage diseases, but is too late for many parts of the state. Baltimore is well colored, free from cracking, productive, and fairly resistant to foliage diseases, but is subject to blossom-end rot. All things considered, the first three varieties named are most desirable, and efforts should be made to secure the strains which lead in desirable characteristics and have fewest undesirable ones. Differences among strains which appeared in trials will be discussed.

Among sweet corn varieties, attention should be given to the newer hybrid sorts which are specially desirable for canning because of uniformity in size, quality, plant characteristics, and time of maturity. As with tomatoes, most varieties have both desirable and undesirable characteristics. Golden Cross Hybrid or Golden Cross Bantam leads in productiveness, uniformity, disease-resistance, and sturdiness in plant, and edible quality is very good, but kernels are not very deep. Bancross 201.39 is suitable where eight-row corn is preferred; Golden Colonel has very deep kernels, but is not so high in flavor as are some other varieties, nor is it so productive as Golden Cross Hybrid. If white canning varieties are desired, the Stowell and County Gentlemen hybrids should be given a trial. Marcross 6 and Spancross 2 were the earliest good-quality varieties in 1936 trials which could be depended upon to produce a crop if wilt-disease were present.

The pea-canning industry is looking for an early variety which has the productiveness and reliability of Alaska and in addition has a good, sweet flavor. Wisconsin Early Sweet and Surprise appeared to be fairly satisfactory in 1936, though in trials at State College the former variety was more severely damaged by root-rot than were Alaska or Surprise. Early Perfectah, Wilt-Resistant Perfection, and Perfectah also appeared to good advantage, both in productiveness, quality, and uniformity of maturity.

Among market pea varieties, World Record, Thomas Laxton, Laxton Progress, Hundredfold, Morse Market, Stride Type (Giant Stride, Stridah, Wyoming Wonder, Midseason Giant, Icer, and Duplex), and Dwarf Alderman (Asgrow 40) provided a succession of desirable, dark green, large-podded, dwarf varieties of high quality.

Cabbage Growing in Pennsylvania

W. B. Nissley
State College, Pa.

The most successful cabbage growers are those who grow several or more acres each year; with them it is one of their main crops and a substantial source of income. The small grower of a fraction of an acre to several acres usually grows a variety of crops and does not have the same interest as the larger grower in source of seed, plant growing, and general cultural practices.

With some exceptions most growers use Golden Acre for first early, Copenhagen Market for second early, Glory of Enkhuizen or Large Late Copenhagen Market for summer and kraut season, and Short Stem Danish Ballhead for winter storage.

Seed for the first early crop is sown in greenhouses in January or February, the transplanted plants transferred to cold-frames in March and planted in the field in April.

Where greenhouses are not available and hotbeds are used, seed is sown in March and the plants are ready for the field by May. They may be either transplanted in the frames or thinned as desired.

Seed for the late crop is sown in carefully prepared outdoor seed beds May 10 to 15 and set in the field June 20 to July 1. To grow late cabbage plants select a fertile piece of ground not infested with cabbage diseases. The seed bed should be well prepared, comparatively free from weed seed and should contain sufficient organic matter to handle well. Manure turned under a month in advance of seeding and the ground harrowed periodically is good. Broadcast a complete fertilizer prior to seeding and work it into the soil to a good depth. One pound of seed should produce plants for from 2 to 4 acres. Drill the seed thinly in rows about 15 inches apart. Practice frequent shallow cultivation, thin the plants to 3 or 4 per inch. A good cabbage plant is short and stocky and has a pliable stem and a good root system.

Cabbage responds quickly to good treatment such as a good soil, proper fertilizer, sufficient moisture, and frequent shallow cultivation. A sod plowed under in the fall and the soil harrowed periodically during the spring months to planting time is fine.

A cover crop plowed under in the spring also is good. Manure turned under is a treatment practiced by many growers. In addition to the above practices a complete fertilizer such as a 4-12-4 or 4-16-4 at the rate of 400 to 800 pounds per acre is fine. A row application of several hundred pounds worked deeply into the soil with the remainder broadcast is popular. Planting distances range from 18" by 30" to 24" by 36" for early cabbage and 20" by 30" to 36" by 36" for late cabbage. Five to seven cultivations should be given, depending upon weed growth.

General Control Measures for Cabbage Diseases

O. D. Burke and R. S. Kirby,
State College, Pa.

Aside from specific measures which apply to definite diseases, a general disease control program can be set up for cabbage that will insure a minimum loss each year. These general practices are listed and discussed briefly below:

1. All seed should be treated to destroy disease-causing organisms in or on them. If it were possible to obtain seed from plants known to be healthy this step would not be needed, but most of the seed used is of uncertain origin. The hot water treatment is effective against bacteria or fungi either within or on the seed. Place the seed to be treated in small cheesecloth bags. Place in water at 122°F. for 25 minutes; then remove and immediately plunge into cold water. The seed should be spread out and dried or planted immediately. The temperature range is very narrow at which effective killing of disease-causing organisms is secured without reducing germination of the seed. A thermometer at the same depth as the seed should be used to check the temperature during the treatment.

Compounds containing either organic mercury or calomel applied after the hot water treatment increase the come-up and prevent damping off or wire stem. Organic mercurials should be used as directed on the container. If calomel is used, do not use the organic mercurial, but apply one pound of the powder to each pound of moistened seed. A sticker consisting of one-half pound of gum arabic dissolved in one quart of water and used to dampen the seed before dusting with the calomel causes it to adhere and increases the efficiency of the treatment.

2. The soil used for the seedbed should be one which has never had cabbage on it or one which has been thoroughly sterilized. A soil that has had cabbage refuse applied in the manures is unfit for cabbage beds unless it is sterilized.

3. The location of the seedbed is important. Care must be taken to prevent drainage water from old cabbage fields, or from cabbage refuse, reaching the seedbed. Many of the cabbage diseases affect other plants similar to cabbage, therefore, the seedbed may be contaminated by placing it near a weed patch.

4. Use corrosive sublimate as a drench as soon as the plants are up and repeat at weekly intervals until the plants are set in the field. The proper strength of corrosive sublimate to use is one ounce in $7\frac{1}{2}$ gallons of water (approximately 1-1000). This material is a poison which may be bought at any drug store. It is highly corrosive and should be used in glass, wooden, or earthenware containers, since it will soon destroy galvanized or other metal pails. The drench is injurious to the tops and should be applied so that only the roots are wetted. When the plants are small, one gallon will do for 40 feet of row, but more is needed as the plants become larger. Apply as soon as the plants are up and at weekly intervals until they are set in the field.

5. Any bed showing diseased plants should be discarded. Transferring such plants to the field will result in the infection of the whole field.

6. In the field, practice rotations, preferably 3 to 7 or more years. In outlining a rotation, the grower must consider the diseases to be controlled and the fact that most of the cabbage diseases affect many cruciferous crops, such as cauliflower, kale, brussel sprouts, turnips, and mustard. Including such crops in the rotation will only serve to intensify the situation.

7. Cabbage refuse should not be included in the manures placed on land on which cabbage is to be grown. To do so will often carry the disease-causing organisms to the field.

8. Plant as shallow as soil moisture permits. Deeper planting increases damping-off.

9. The use of hydrated lime to bring the field to pH 7.2 is very effective in the control of club root. The lime should be applied six weeks to two months before the cabbage is set out, and disced or harrowed into the soil. If the soil is already at the desired pH, it is still necessary to use hydrated lime at the rate of 1500 pounds to the acre to control this disease.

10. In fields where yellows has appeared, use seed that is resistant, as soil and seed treatments will not control this disease. (From Circular 169, Pa. Agr. Ext. Service)

In accordance with a resolution adopted last year by the Pennsylvania Vegetable Growers' Association, a series of letters on control of vegetable diseases has been arranged, and the first and second of this series are now in the hands of County Agents, for distribution among growers.

The first letter is general in nature and presents the problems, suggesting the ways of preventing or controlling disease in vegetables. All later letters will be more definite and contain information of immediate value. The second letter, summarizes varietal resistance to disease of different kinds of vegetables; the third will be on vegetable seed treatment. Later letters will deal with the specific diseases of important vegetable crops and with situations that develop during the growing season.

Pyrethrum, Rotenone and Other Non-Poisonous Insecticides for the Vegetable Grower

R. E. Culbertson
State College, Pa.

At the request of Secretary Wallace, the National Academy of Science has appointed a committee for the purpose of reviewing the research program on toxicity of lead and arsenic now under way in the Food and Drug Administration. An article in the current issue of Public Health Reports discusses spray controlling laws in considerable detail. Thus the matter of producing fruit and vegetables which are potentially not dangerous to the consumer is again brought forcibly to our attention.

Pure food and public health officials have ruled against the marketing of fruits and vegetables bearing excessive quantities of arsenic, lead, or fluorine. The United States Department of Agriculture has established the following tolerances for spray residues: lead 0.018 grain Pb per pound; arsenic 0.01 grain AS_2O_3 per pound; and fluorine, 0.01 grain F per pound. "In order to meet these tolerances the grower must either go to the added expense of chemically washing his crop or use insecticides of low toxicity to man."

"Colorado and Michigan are the only states which give the department of health the power to enforce regulations for spray amounts. Sprayed fruits and vegetables shipped in inter-state commerce are subjected to federal inspection but fruits and vegetables sold within the state where they are grown are without this safety control."

Lead poisoning effects the red corpuscles of the blood. The blood of normal adults rarely contains more than 1% of red corpuscles that take a basic stain. In workers absorbing lead without clinical manifestation and in early lead poisoning, the per cent commonly ranges from 1.5 to 4.0 with occasional finding up to 20.

"A case has been reported from California where three dairy cows became quite sick when fed on alfalfa in a field adjacent to a field of tomatoes that had been treated with calcium arsenate by airplane. The cows lost weight, fell down in milk production, and were still below normal weight two months after the first effects of poisoning were noticed. Thus the factor of effect on livestock in airplane dusting with arsenical enters the picture."

Pyrethrum is the common name of the Composite, Chrysanthemum cinerariaefolium, a perennial plant whose flower resembles the common field daisy. It is native to Dalmatia and is the base of most of the household insecticides such as Flit and Black Flag and of many agricultural insecticides such as Evergreen, Red Arrow, Pyrote, etc.

The United States imports annually some 13,000,000 pounds of dried flowers valued at almost \$2,500,000. About 92% of this comes from Japan and the remainder is imported from Italy, Dalmatia, Southern Russia and the Kenya Colony in Africa.

Pyrethrum, whether in powder or in liquid spray, is very poisonous to insects and cold blooded animals, and non-poisonous to man and other warm blooded animals. It is harmless to plants. It produces death by the destruction of the cells of the central nervous system accompanied by paralysis. The toxic principle is absorbed directly through the body integument and very little by penetration of the spiracles or ingestion through the mouth parts. The toxicity of pyrethrum flowers is due to Pyrethrin I and Pyrethrin II. They are commonly spoken of as pyrethrins and good flowers analyze .7 to 1.25% total pyrethrins.

Pyrethrum kills both sucking and chewing insects and the extent of its use depends largely on the correct concentration and the cost.

The objection to pyrethrum insecticides is that they readily decompose and lose their toxic properties when exposed to air, heat, light, alkalies, and inorganic acids. Pyrethrum, however, is quite stable in petroleum oil. In dust form, if kept in a closed can, it keeps its effectiveness for at least three years.

In using pyrethrum insecticides, it should be remembered that

1. They are applied only for immediate kill.
2. Sprays are usually more effective than dusts.
3. Dusting should be done when the foliage is dry for greatest mortality.
4. Control is better at high temperatures.
5. The materials are more toxic following periods of dry weather.

Rotenone

Rotenone is a compound derived principally from the roots of certain fish-poison plants. It is 30 times as toxic as lead arsenate as a stomach poison to the silk worm, 15 times as toxic as nicotine upon bean aphids and 25 times as toxic as potassium cyanide to gold fish; yet it is relatively harmless to birds and mammal eating it the strengths generally recommended in insect control practices. It is used in commercial insecticides intended for use as flea powders, fly sprays, and greenhouse and horticultural sprays and dusts.

Rotenone has been found in seven genera of the bean family, but the chief source is from Denis elliptica and D. malaccensis, grown in the East Indies and the Malay peninsula, and from Cliocarpus nicou (Cubé) - which is native to Peru. Cracca virginiana (Devil's Shoe String), a common weed found in the United States, contains Rotenone and cultural plots have been established in several of the southern states to determine whether its commercial production is feasible.

The United States imports about 1,000,000 pounds of Derris and 500,000 pounds of cubé annually.

Action of Rotenone: In contrast with pyrethrum which affects the nervous system, the most characteristic effect of rotenone is on respiration; death results from respiratory failure. Action is slow, requiring at least 48 hours. Rotenone is both a contact and a stomach poison, but when used as a stomach poison it readily decomposes when exposed to sunlight. It is destroyed by alkalis and its aqueous emulsions are unstable. The chemical extract lose their toxicity faster than does the powder. Furthermore, when applied as a dust or with the powder in water, more of the active principles are available per unit cost than when a concentrated spray is diluted with water.

In addition to rotenone, derris and cubé contain other constituents such as deguelin, tephrosin, toxicarol, etc. Deguelin and tephrosin rival nicotine in contact insecticidal action. Therefore, when you purchase either derris or cubé, the actual killing power is higher than that indicated by the rotenone content and it is now customary to express both the percentage of rotenone and total extractives found in the powder.

Derris and cubé dusts are very generally recommended in the vegetable industry as substitutes for arsenical in the control of bean beetles, cucumber beetles, cabbage worms, squash vine borers, etc. It is of interest to note that the corn ear worm, serious at times on celery, decidedly does not respond to rotenone compound.

Nicotine: In addition to being a contact insecticide, nicotine is a distinct stomach poison to many insects when taken into the digestive system. One of the principal difficulties with its use in the past has been its volatility and lack of adherence to the sprayed object. Nicotine in its free form disappears from sprayed foliage within a few hours after spraying. Nicotine sulfate is not so volatile but disappears rapidly in an alkaline medium. The dusts leave more nicotine on the foliage but have not proven satisfactory as a substitute for arsenicals.

The use of tannic acid or bentonite together with nicotine - however, results in an appreciable amount of the material adhering to the foliage.

A new nicotine oil spray that is claimed to kill all insect pests of gardening fruit and vegetable crops has recently been announced by the Experiment Station at the University of Kentucky. It is both a contact and stomach poison and is applied as a mist or fog. The oil is highly refined and not injurious to foliage.

Other Materials:

1. Lauryl rhodanate, sold under the name "Loro", is reported as being more effective than nicotine on some of the more resistant sucking insects.

2. Soybean oil, in combination with oleic acid and ammonia, has given a 95% kill of aphis rumicis.

3. Baricide is satisfactory in the control of the Mexican bean beetle; it must be remembered, however, that this is a fluorine compound.

4. Zinc compound. Zinc arsenate is as effective as lead arsenate in codling moth control and its use at least eliminates the danger of lead poisoning. Dr. R. C. Roark, Chief of the Insecticide Division, U. S. D. A., says "At present we see the inorganic insecticides, especially arsenical, dominate the market. In the future we shall see arsenic lead, fluorine, mercury, thallium, boron, selenium, and other inorganic material largely replaced by organic products."

Methods of Solving the Labor Problem

Gilbert S. Watts
Bellwood, Pa.

Speaking as a vegetable grower I can say that most of us have complained often about dull markets during the last few years. Now we are beginning to worry about the availability of labor. Perhaps there is a relationship that means we will have better markets as the labor supply diminishes. In looking back through my books the other day I noted that with one or two exceptions we had our best profits in the years when we had to pay the highest wages to secure enough help.

This topic is a difficult one. Perhaps the best approach is to try to set down some of the different means of contending with the factors of scarcity or costliness of labor.

Undoubtedly a most effective means is to secure high yields. Let us note what a labor cost of $75.00 per acre, not unusual in producing intensive crops, amounts to per package with varying yields. With 200 packages per acre the cost is 37½¢, with 250 it is 30¢, with 300 it is 25¢ and with 500 it drops down to only 15¢. High yields provide enough income to earn good wages for the laborer and a satisfactory profit for the manager. But low yields can not produce enough net income to content either. In addition good crops attract laborers. Everyone likes to work in bountiful crops, and this is particularly true where the pay is on a piece basis.

Although there are limitations to its use on the farm piece work is an important possibility in certain operations. Very often it may be the means of enabling workers to earn higher wages and to do so without increased cost per unit of output. However, piece work basis of pay must not be looked upon as a means of grinding down too hard on costs or quality of workmanship will suffer in proportion. It has been my experience that the piece rate basis is very satisfactory in harvesting peas, beans and berries and we try to adjust rates from time to time so that the worker who takes time to do a first class job can earn somewhat more than he would have earned at his hourly rate. With that set up he makes a little more and our cost is a little less than with the hour rate.

Saving labor at every possible turn can not be neglected in our effort to solve the labor problem. Saving labor may be accomplished in many connections and time does not permit going into detail. About all we can do here is to set down a few of the categories under which labor saving activities may be instituted. Perhaps we can employ more direct ways of doing the little things, like bunching radishes or carrots, or setting plants.

In many instances more direct ways of doing the big things may be devised. I know we and many other growers have found equally good results from discing in certain cover crops as compared to plowing and fitting and drilling in the conventional manner that we use in planting a crop for grain. High class supervision, able foremen, is essential to saving of labor. A top notch supervisor get results by teaching his gang how to do the job most easily and effectively. Under less capable supervision a gang actually may be required to work harder with less being accomplished.

Saving labor by use of machinery is a subject in itself. We can not buy every new gadget that comes along but it does pay well to keep our heads up and our eyes open for the machines that fit our needs in both the field and the packing room.

One of the greatest savers of labor is to eliminate in so far as it is possible the great losses of effort that are entailed by failure. We all have failures that we could have avoided. Failure on account of poor germination of untested seed, failure because lime was not applied when needed, failure because seed was not treated, failure because spraying was not started in time, and many others are potent wasters of labor.

Timeliness in plowing or harrowing when the soil is most friable, timeliness in planting or cultivating at just the right stage, timeliness in harvesting when little trimming or grading is required both save labor and provide the most return for the labor expended.

Percision as exemplified in planting at just the right depth and rate, in cultivating close to the row and at the most suitable depth, in adjustment of the sprayer nozzles requires no more labor than to do these things incorrectly, and the yield is increased.

Arrangement and length of fields, location of driveways and the general organization of field work and transportation to and from the field merit attention. Many growers are finding changes advantageous, particularly in rearranging for tractor farming.

In some cases it may be necessary in solving the labor problem to make changes in the kinds or sequences of crops grown. Thus the labor requirement can be raised or lowered to a considerable degree. Whereas one grower with an abundance of available hand labor may find it advantageous to increase the crops requiring much hand work another may profit by growing a larger proportion of crops that require relatively little hand work. Another point that applies in many cases is to design the cropping plan to call for a fairly constant amount of labor from early spring until late fall. After all this is an individual problem.

-o-o-o-o-o-

If your dues have not been paid for 1937, remember to forward one dollar to the Secretary-Treasurer, Warren B. Mack, State College, Pa., to insure receipt of other issues of the News, and to provide funds for obtaining the best qualified speakers for the annual programs.

PENNSYLVANIA VEGETABLE GROWERS' NEWS

Vol. VII July, 1937 No. 2

Publication of the Pennsylvania Vegetable Growers' Association
John M. Willson, Belle Vernon - - - - - - - - President
A. C. Thompson, Morrisville - - - - - - -Vice-President
W. B. Mack, State College - - - - - Secretary-Treasurer

Experiments on Vegetables at State College

This issue of the News is somewhat belated because your Secretary, who seems unable to induce anyone else to contribute to the News or to write it for him, has been busy in organizing vegetable experiments and recording the results. Because these experiments may bring forth information valuable to vegetable growers, it is in order to describe some of them, and to state tentatively what the results of some of them appear to be.

Granulated Fertilizer Tests

A series of tests is being made of granular complete fertilizer in comparison with ordinary powdered fertilizer of the same analysis. The experiments are being conducted with different crops and at different times during the season. The crops being grown are spinach and carrots as representatives of closely spaced row crops and cabbage and beans of more widely spaced crops. Applications to the spinach and carrots have been at the rate of 1000 lb. per acre of 4-16-4 fertilizer broadcast; to cabbage, 750 lb. of 4-16-4 fertilizer per acre, in a band 3 inches from the row; and to beans, 400 lb. of 4-16-4 per acre, in a band 2½ inches from the row.

One test of spinach and a test with cabbage have been completed, and, though the results have not been compared by statistical procedures, it appears that both forms of fertilizer are equally good.

The test with carrots is nearly complete, and that with beans is just nicely started. So far, both granulated and ordinary forms appear to be about equal on these crops. A second test with spinach is contemplated for the fall crop.

Test of Rare Element Mixtures with Cabbage

An experiment is in progress to find out the possible effect of certain secondary plant-food elements on cabbage which is supplied an ample amount of the ordinary plant foods, nitrogen, phosphoric acid, and potash. A mixture prepared by the American Cyanamid Company, containing 63 different elements, among them iron, manganese, chromium, boron, zinc, copper, iodine, tin, lithium, barium, strontium, and bromine, is being used. Thirty of the better known ones are contained in the mixture in approximately the same proportions as those in which they have been found by numerous analyses of plant ash, and the remaining 33, including numerous rare elements such as uranium, radium, tantalum, and cerium, are present in small amounts considered to be sufficient that they are not limiting in their effects on growth.

The cabbage in this experiment is being cut now; the mixture of materials appears not to improve yields above those secured from well-balanced fertilizers made from the usual commercial materials, but no conclusions should be drawn until all results are complete.

Fertilizer Requirements of Truck Crops

The 408 plots of the long-time fertilizer experiment with sweet corn, tomatoes, cabbage, and potatoes are planted as usual, and the crops generally are in excellent condition. This year, before fertilizers were applied, the acidity in terms of PH and the lime requirement of each plot were ascertained, and an amount of ground limestone equal to about four-fifth of the theoretical total lime requirement was added. Out-of-date or commercially unavailable carriers of plant food, such as dried blood and Thomas slag, have been dropped from the experiment, and new ones, such as urea, ammonium phosphate (Ammo-phos), and a combination of nitrate of soda and tankage have been introduced.

Good growth of all crops is in evidence with all of the new nitrogen carriers, and the value of proper PH of the soil in securing best results from sulfate of ammonia is beginning to appear.

Asparagus Fertilizer Experiments

Experiments with asparagus fertilizers have raised the question regarding the importance of proper placement of phosphorus and potash for best results from these materials.

Variety and Strain Tests

The enclosed notice of the forthcoming Vegetable Field Day, which will be the summer meeting of the Pennsylvania Vegetable Growers' Association, tells how many different strains and varieties of each kind of vegetable will be seen on August 20. No mention is made of trials of 32 strains of lettuce, in addition to a large number of crosses and selections, 63 strains of peas, 34 strains of radishes, and 26 of spinach, which have already been completed.

In the radish trials, strains of Saxa, Scarlet Globe, Comet, Cavalier, and Glowing Ball appeared to good advantage. Scarlet Globe and Glowing Ball in general had somewhat larger tops than the others, but the roots of the good strains of these varieties differed little in size and shape. Glowing Ball has a very attractive, bright scarlet color.

Among spinach strains which were especially promising were Dark Green Bloomsdale and several strains of Juliana. Juliana and Summer Savoy were more longstanding than other varieties.

Among commercial lettuce strains, none excelled New York No.12 and New York No. 515, among the crisp heading types.

Dark Podded Thomas Laxton, Superlaska, Perfection, Laxton Progress, Alderman, Ace, Wisconsin Early Sweet, Gradah, Asgrow #80, Mardelah, Canner King, Climax, and Surprise were among the higher yielding strains, in trials planted in the usual manner for canning peas. Statistics on weight of shelled peas per acre, weight of peas per 100 pods, sizes of peas, height of vine, color of pods and peas, and freedom from diseases and insects are being compiled from the results of the tests.

Summer Meeting of the Association August 20

Plan to attend the Summer Meeting of the Pennsylvania Vegetable Growers' Association, in connection with the Vegetable Field Day at State College, for which an invitation is enclosed herewith. This lists all of the interesting tests which may be seen. A visit to these trials may make you acquainted with a half-dozen or more varieties which will exactly suit your requirements, and with methods of culture which will save you money and labor.

State College is located amid some of the most beautiful scenery of the State. Picnic facilities are present on the campus and in nearby woods and mountains. Go on a picnic which will pay in information as well as relaxation!

Research and College Relations Committee

In accordance with a resolution passed at the meeting in last January at Harrisburg, President John M. Willson appointed Gilbert S. Watts of Bellwood, and A. C. Thompson of Morrisville, to serve with him on the Committee on Research and Relations with the Agricultural Experiment Station. A movement is now in progress to enlarge this committee, and to make it also an Advisory Committee of the Agricultural Experiment Station for the vegetable industry. Further announcements will be made as progress is made on this matter.

To make these committees effective, send your suggestions of important subjects for research to members of the committee or to the Secretary. All suggestions will be welcome. If your most urgent questions are to be answered, they must be asked!

Rotenone Dusts

Your Secretary has compiled a partial list of firms which sell rotenone dusts. These are being widely recommended as all-around insecticides which leave no poison residue on vegetables, but many growers are unable to purchase them in their local markets. If you want this list, send a post-card to the Secretary.

Many persons have the impression that rotenone is non-poisonous to warm-blooded animals. This is not altogether accurate. The toxicity of rotenone, which is the active insecticidal principle of derris dusts and sprays and which is present in the ordinary ready-mixed dusts to the extent of from one-half to one percent, has been found to be about two-fifths of that of pure nicotine, in experiments in which these materials were fed to rats or cats as test animals. The minumum dose of nicotine required to kill cats was .01 gram per kilogram of body weight; that of rotenone required to kill rats was .025 gram per kilogram of body weight, or 2½ times as much.

Neither nicotine nor rotenone, however, leave any poison residue on vegetables after a few days, because for former evaporates, and the latter is rendered inactive after four or five days' exposure to air and light.

PENNSYLVANIA VEGETABLE GROWERS' NEWS

Volume VII October, 1937 No. 3

Publication of the Pennsylvania Vegetable Growers' Association
John M. Willson, Belle Vernon - - - - - - - - President
A. C. Thompson, Morrisville - - - - - - Vice- President
W. B. Mack, State College - - - - - Secretary-Treasurer

Suggestions Wanted

The Program Committee (Amos H. Funk, Millersville; A. C. Thompson, King Farms Co., Morrisville; H. S. Mills, Box 358, Bristol; J. M. Huffington, State College; and the Secretary ex officio) is faced with its annual job of arranging a program for the Annual Meeting at Harrisburg in January, which will answer as many as possible of the questions uppermost in growers' minds, or which may become uppermost during the next year. The members of the Committee have some ideas, but more are needed to make the best possible program. Send your suggestions of subjects and speakers to any member of the Committee, and he will pass them on to the Secretary; or, send them directly to the Secretary.

Dr. Grant B. Snyder, Head of the Department of Vegetable Gardening at the Massachusetts State College, has been secured as judge of the vegetable exhibit in the Farm Show. He has studied the culture of market tomatoes on stakes, a method which is increasing in popularity in New England, and has conducted other studies on varieties and culture methods. He will present one or two talks which should be interesting and instructive.

The program will have to be prepared soon, to be included in the General Program of the Farm Show.

PLEASE SEND YOUR SUGGESTIONS AT ONCE!

Liming Vegetable Soils

Our friend, Professor J. W. (Jack) White has stated that farmers of Pennsylvania on the average are applying only about one-half as much lime as they might use profitably. To secure best results from lime, it must be applied in the amounts required, as indicated by tests of the soil.

When the results of tests are stated in terms of pounds to the acre, the problem is solved in a general way. Certain crops, however, are known to thrive better on soils which are not absolutely neutral, some requiring distinctly acid soils and others somewhat alkaline.

When soil acidity is measured in terms of pH, either test applications must be made and the results determined by later pH measurements, or a scale of lime requirements for different pH values must be made for a particular soil. For general guidance, such a scale has been made in tabular form by Dr. M. F. Morgan, Chief Agronomist of the Connecticut Agricultural Experiment Station, and has been presented in The Fertilizer Review, a publication of the National Fertilizer Association. Dr. Morgan has shown graphically the best pH range for the common crops, and a part of his chart including the common vegetables, together with the amount of lime to secure the desired pH on various soils, with different pH values before treatment.

The table and chart are used as illustrated by the following example: If your soil is a medium loam with medium organic content and with a pH of 5.2, and it is desired to grow sweet corn on it, which requires for best growth a pH range from about 5.6 to 6.5, or about 6.0 on the average, the amount of ground limestone to use will be found in the middle section of the table, "Desired pH 6.0, under Soil Group 3, and in the line with 5.2 as the "pH of soil tested," or 1.7 tons to the acre.

The table and chart just described will be found on pages 6 and 7.

Growing Vegetables in Nutrient Solutions

("Soilless Agriculture")

While we do not think that vegetable growers on truck farms need worry about competition of corporation farmers, who grow vegetables in tanks of water containing chemical solutions in the open, the fear has already been expressed by greenhouse vegetable growers that promoters may secure financial backing for tank culture of tomatoes, cucumbers, etc., in greenhouses, and may flood the markets for greenhouse products. This fear may be ill-founded; if it actually becomes cheaper to grow greenhouse tomatoes in liquid culture, there should be no reason why greenhouse growers already in the business could not change their methods to the new and improved ones.

As a matter of fact, most of the concern about tank agriculture has been displayed by the general public, by amateur gardeners, and by high school biology students. Because of widespread public interest, however, as shown by numerous inquiries received by agricultural experiment stations, colleges, etc., we are including in the News a brief review of the subject, prepared by your Secretary.

NUTRIENT SOLUTION CULTURE OF VEGETABLES

Warren B. Mack

An experiment which is now considered a classic in the study of plant nutrition was conducted by Van Helmont, who lived from 1577 to 1644. He grew a willow branch of which the original weight was 5 pounds in a tub containing 200 pounds of soil, watered the branch with rain water, and found that the rooted branch at the end of 5 years weighed 164 pounds, while the soil had lost only two ounces in weight. Van Helmont concluded incorrectly that the dry matter of the branch and of the leaves which it had produced came almost entirely from water; if he had said that most of it did not come from the soil, he would have been correct.

He did not suspect, of course, that a considerable proportion of the dry matter of the willow branch was from the air. This fact was established by J. Senebier about 150 years later, in 1782; this investigator found that carbon dioxide was assimilated by green plants in sunlight, and that this assimilation was a nutritive process, because the plant gained in dry weight as a result of it. Van Helmont must be credited with the discovery that very little of the dry weight of plants actually comes from the soil. Stephen Hales, an English physiologist and inventor, made observations in 1727 that plants obtain some nourishment from the air. It remained for Senebier, however, to establish this fact quantitatively.

It is doubtful that the discovery can be credited to one person that plants could be grown without soil, simply by placing their roots in a solution of mineral salts and nitrogen compounds. Water-culture was practiced at least 238 years ago, and probably before that time. John Woodward, an English botanist, reported the culture of spearmint, potatoes, and vetch in spring and river water in 1699, and also used solutions of inorganic salts. This method of plant culture was revived by Julius von Sachs, a German botanist and plant physiologist who lived from 1832 to 1897, for the purpose of studying the nutrition of plants. Sachs said in his Lessons on Plant Physiology, written in 1882, "In the year 1860 I published the results of investigations which demonstrated that land plants could obtain their nourishment from water solutions without the help of soil, and that it is possible in this way not only to maintain plants alive and growing for a long time, but to obtain a considerable increase in their organic substance and at the same time to produce viable seeds." Wilhelm Knop, another German physiologist, and Nobbe also pursued this kind of study, and published an extensive report of experiments in 1868. The last two investigators are noted for their perfecting of a four-salt solution in which it was possible to grow plants successfully, the so-called Knop's solution, consisting of one part each of potassium nitrate, potassium diphosphate, and magnesium sulfate, and four parts of calcium nitrate, in a 0.1 to 0.5 percent solution in water, with a trace of ferric phosphate.

Since Knop's time, the use of nutrient solutions has been a generally accepted method for studying the nutrition of plants. In this country, W. E. Tottingham of the University of Wisconsin, J. W. Shive of Rutgers University, S. F. Trelease of Columbia University, and W. F. Gericke of the University of California have become noted for their studies of nutrient solution culture of plants, and some of the most noteworthy of their studies have been carried out in the Laboratory of Plant Physiology of the Johns Hopkins University, under the direction of Dr. Burton E. Livingston. In 1918, a committee of the National Research Council under the direction of Dr. Livingston organized a cooperative study of nutrient solution cultures on a nation-wide basis, which was to be carried out under a coordinated plan by colleges, universities, and experiment stations throughout the United States.

A modification of the solution-culture method for the study of plant nutrition has been used widely during the present century. This method is the introduction of washed quartz sand, into which the solutions are introduced just as water would be applied to soil, for the purpose of duplicating more closely the conditions of aeration and capillarity found in soils. The method was first developed by Hellriegel, a German plant physiologist, in 1888.

The commercial production of crop plants in nutrient-solution cultures is a development of the past few years. Investigations on the commercial production of cut-flowers were begun at Rutgers University in 1929, when carnations were grown in sand cultures by Biekart and Connors. Their studies were reported in Bulletin 588 of the New Jersey Agricultural Experiment Station, published in 1935. In this report, it is shown that carnations can be grown in nutrient solutions at a cost closely comparable with that of soil culture in the greenhouse. Several solutions were used, but the most practical one was made of 112 grams of ammonium sulfate, 210 grams of monopotassium phosphate, 420 grams of magnesium sulfate, and 1800 grams of calcium nitrate in 185 gallons of tap water.

The widespread interest shown in nutrient-solution cultures originated with the publication in 1936 of an article by W. F. Gericke and J. R. Tavernetti in Agricultural Engineering, Volume 17, pages 141 and 142, entitled Heating of liquid culture media for tomato production. These investigators described an experiment in which tomatoes were grown in tanks 2½ feet wide, 10 feet long, and 8 inches deep, filled with nutrient solution and covered with wooden frames supporting poultry wire on which excelsior and sawdust were spread. The composition of the culture solution was not specified, but it may be assumed that it was not widely different from those in general use. Temperatures were maintained by means of General Electric heating cables, at 70-75 and 80-85 degrees F. in different tanks, and best yields were obtained with one variety of tomato, Majestic, at the higher temperature, but with the other, Best of All, at the lower temperature. The maximum yield for a single tank, computed on an acre basis, allowing no space for paths, etc., between tanks, was 306.8 tons of tomatoes per acre. Maximum electrical current consumption was 428 kilowatt hours per tank for a 5½ months' period.

This publication aroused wide interest, and popular articles on the subject have appeared in a great variety of publications: Time, Market Growers' Journal, Pacific Rural Press, Scientific American, Popular Science, Electrical West, Christian Science Monitor, American Fertilizer, Business Week, Food Industries, Christian Century, and practically all the daily papers.

Commercial installations have been made in several greenhouses in California, and one, that of Vetterle and Reinert, at Capitola, California, has been reported to have produced a crop at a cost

comparable to that of greenhouse tomatoes by older methods. In one 80 x 200 ft. house, electrical current consumption has been an average of 30,000 kilowatt hours per month.

A modification of the earlier method of heating by means of electric cables has been devised in one establishment, in which the nutrient solution is circulated through a boiler, and combines a hot-water heating system with the nutrition of the crop.

Some of the methods in use are the following;

Gericke Method. Tanks are made of wood or concrete, about 2½ feet wide, 10 feet long, and one foot deep, with wooden racks with poultry wire bottoms containing about 4 inches of excelsior, shavings, or sawdust to support the plants, which are trained upon wire and twine trellises. Fresh solutions are supplied every two weeks. Dr. Gericke has not published the formula for his most successful solutions, though he has secured a patent on one formula found by certain investigators not to be particularly valuable.

Withrow Method. This is one of the most successful methods, and has been found fully practical for growing vegetable and flower plants for transplanting into the field. It has been developed by Mr. R. B. Withrow of Purdue University. Tanks are made of wood, about the same as greenhouse benches, but they are made water-tight by sealing with petroleum asphalt free of injurious substances. These tanks are filled with coarse gravel which has been treated with hot water or other material to sterilize it, and this is flooded about 3 times a day with the nutrient solution. The flooding is done by means of an electrically operated pump, from a cistern or tank reservoir below the level of the tank.

Withrow's formula is as follows, for 1000 gallons of solution: sulfate of potash, 42 oz.; anhydrons magnesium sulfate, 18 oz., or epsom salt, 36 oz.; monocalcium phosphate, with less than one per cent fluorine, 28 oz.; potassium nitrate (saltpeter), 92 oz.; sulfate of ammonia, 30 oz.; and calcium sulfate (agricultural gypsum or land plaster) 212 oz.

Be sure to send your program suggestions!

A Table Showing Suggested Lime Application to Adjust Soils to Various pH Levels

Based on Use of Limestone, Broadcast, and Worked Into Soil to Plow Depth---Tons Per Acre

pH of Soil as tested!	SOIL GROUP 1 --- Sandy soils Low OM*	SOIL GROUP 2 --- Sandy soils Medium OM* --- Loamy soils Low OM*	SOIL GROUP 3 --- Sandy soils High OM* --- Loamy soils Medium OM* --- Clay soils Low OM*	SOIL GROUP 4 --- Loamy soils High OM* --- Clay soils Medium OM*
		Desired pH 6.6		
6.0	0.4	0.7	1.0	1.3
5.8	0.6	1.1	1.4	1.9
5.6	0.8	1.3	1.8	2.5
5.4	1.0	1.6	2.2	3.1
5.2	1.2	1.9	2.6	3.7
5.0	1.4	2.1	2.9	4.2
4.8	1.6	2.3	3.2	4.6
4.6	1.8	2.5	3.5	5.0
		Desired pH 6.0		
5.6	0.3	0.6	0.9	1.2
5.4	0.5	0.9	1.3	1.8
5.2	0.7	1.2	1.7	2.4
5.0	0.9	1.5	2.1	3.0
4.8	1.1	1.8	2.5	3.6
4.6	1.3	2.1	2.8	4.1
4.4	1.5	2.2	3.1	4.5
4.2	1.7	2.4	3.4	4.9
		Desired pH 5.4		
5.0	0.2	0.5	0.8	1.1
4.8	0.4	0.8	1.2	1.7
4.6	0.6	1.1	1.6	2.3
4.4	0.8	1.4	2.0	2.9
4.2	1.0	1.7	2.4	3.5
4.0	1.2	1.9	2.7	4.0
3.8	1.4	2.1	3.0	4.4

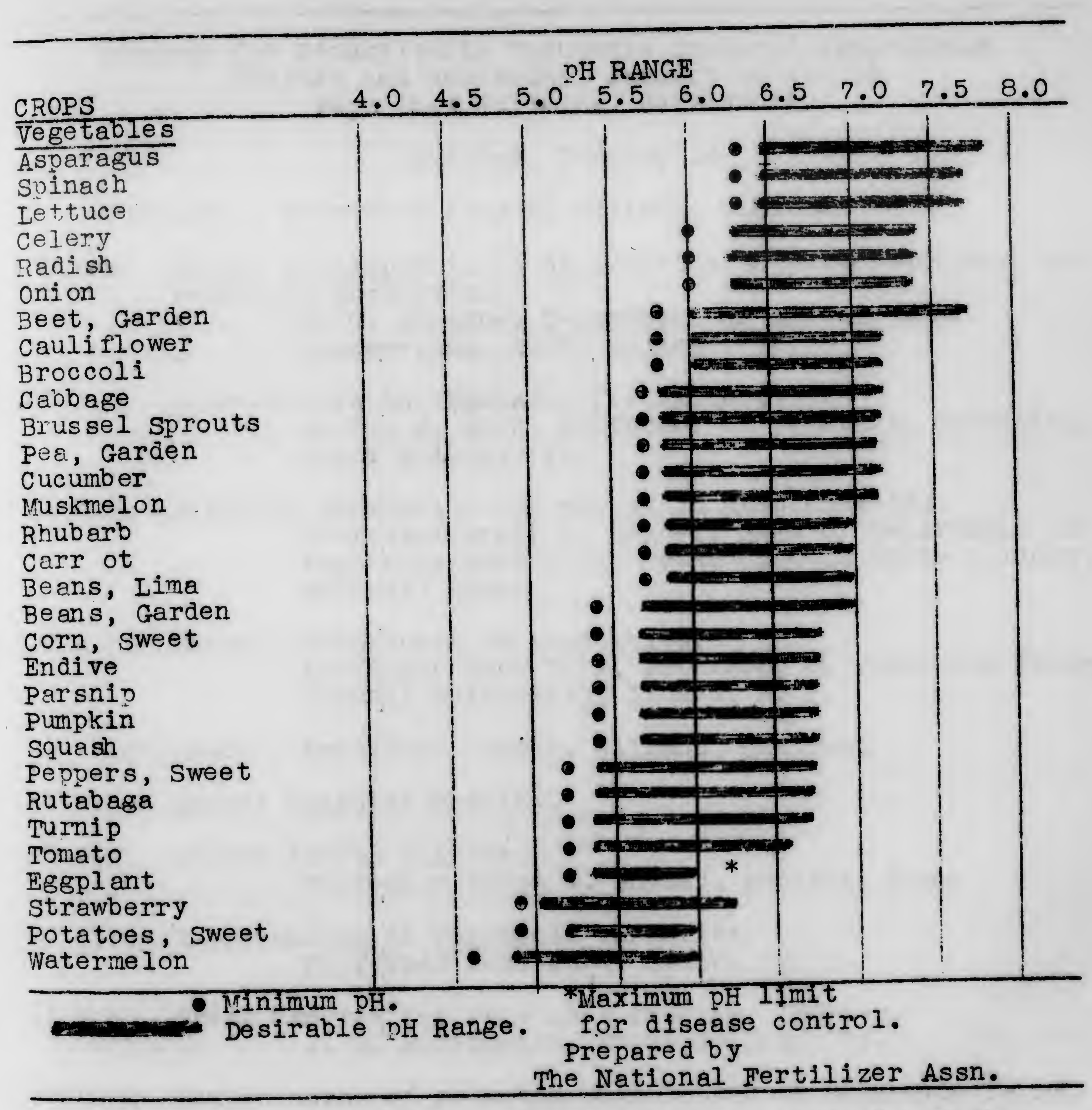
! Based on pH in early spring or late fall. For summer tests, add 0.5 pH for Soil Group 1 - to pH as tested before using table.
0.4 " " " " 2
0.3 " " " " 3
0.2 " " " " 4

* OM - Organic matter content.

From The Fertilizer Review

MINIMUM pH AND DESIRABLE pH RANGE FOR NEW ENGLAND CROPS

Arranged by M. F. Morgan.



*Editor's Note: The pH scale is used for measuring both acidity and alkalinity. It contains 14 divisions known at pH units. It is centered around pH 7 which is neutral. Values from 7 down to zero constitute the acid range and from 7 to 14 the alkaline range. Very few soils have pH value below 4 or above 8. Mch.-Apr. 1937 Fert. Review.

PENNSYLVANIA VEGETABLE GROWERS' NEWS

Volume VII December, 1937 No. 4

Program for Pennsylvania Vegetable Growers' Association
Tuesday and Wednesday, January 18 and 19
Farm Show Building, Harrisburg

Tuesday, January 18

Forenoon - President John M. Willson, Chairman

9:30 A.M. Recent developments in application of power equipment to vegetable production.
D. C. Sprague, Department of Agricultural Engineering, State College, Pa.

9:50 A.M. Improvements in vegetable fertilizers.
Warren B. Mack, Professor of Vegetable Gardening, State College, Pa.

10:10 A.M. Handling vegetables for market in Massachusetts.
Professor Grant B. Snyder, Head of Department of Vegetable Gardening, Massachusetts State College, Amherst, Mass.

11:00 A.M. Market preferences in vegetables.
Professor Paul Work, Professor of Vegetable Crops, Cornell University, Ithaca, N. Y.

Afternoon - President John M. Willson, Chairman

1:15 P.M. Annual Business Meeting.

1:45 P.M. Staked tomato culture.
Professor Grant B. Snyder, Amherst, Mass.

2:30 P.M. Improvements in vegetable varieties.
Professor Paul Work, Ithaca, N. Y.

3:15 P.M. Green manures for vegetable growing. (Movies)
J. M. Huffington, State College, Pa.

3:30 P.M. Simple means of reducing soil losses on vegetable farms.
F. G. Bamer, Extension Specialist in Agronomy, State College, Pa.

Wednesday, January 19

Forenoon - A. C. Thompson, Vice President, Chairman.

9:15 A.M. Discoveries in vegetable disease control in 1937. (Movies)
O. D. Burke, Plant Disease Extension Specialist, State College, Pa.

10:00 A.M. Discoveries in vegetable insect control in 1937. (Movies)
J. O. Pepper, Entomology Extension Specialist, State College, Pa.

10:45 A.M. Growing and marketing vegetables in the Pittsburgh area.
John M. Willson, Belle Vernon, Pa.

11:15 A.M. Improved methods in plant growing. (Movies)
W. B. Nissley, Vegetable Gardening Extension Specialist, State College, Pa.

Afternoon - Harry W. Huffnagle, Chairman of Pennsylvania Ten-Ton Tomato Club, Chairman

1:15 P.M. Presentation of prizes and certificates to Pennsylvania Ten-Ton Tomato Club winners.
President John M. Willson, Belle Vernon, and Harry W. Huffnagle.

2:00 P.M. Culture methods for high yields of canning crops.
J. M. Huffington, Vegetable Gardening Extension Specialist, State College, Pa.

2:30 P.M. Labor and cash requirements for producing tomatoes, peas, and sweet corn.
Monroe J. Armes, Farm Management Extension Specialist, State College, Pa.

3:00 P.M. Possibilities in growing vegetables for quick freezing in Pennsylvania.
Dr. Frank App, Manager, Seabrook Farms, Bridgeton, N. J.

3:30 P.M. Variety trials of tomatoes, peas, and sweet corn in 1937.
E. M. Rahn, Division of Vegetable Gardening, State College, Pa.

FERTILIZING VEGETABLE CROPS IN PENNSYLVANIA

Vegetable crops are grown on a wide range of soil types in Pennsylvania, but most of the truck crops which constitute the greater part of the commercial output are produced on loams, silt loams, or clay loams. A few of the market-garden crops on the Delaware river first terrace soils are grown under soil and climatic conditions which are similar to those in New Jersey, and the same fertilizer practices may be followed in these limited areas. For most of the vegetable production of Pennsylvania, however, the quantities and analyses of fertilizers should be somewhat different from those of the seaboard states, and should be more like those of New York or Ohio.

Analyses should vary somewhat for different crops and soil types; the general relations between fertilizer analysis and either soil type or kind of vegetables are well known, however, and need not be discussed at this time.

The relative values of the different plant food elements are established best by field tests, and where experimental evidence is at hand, it should provide the basis for any discussion of fertilizer practices. The following table is presented, therefore, which summarizes certain results of field experiments in progress since 1917, on Hagerstown clay loam soil at State College, Pennsylvania. These results, because in many respects they confirm those of field tests on soils of similar texture in New York and Ohio, may be considered as representing approximately the effects of the different plant food elements on the heavier soil types of this state, on which most of the truck crops are grown.

TABLE 1. RESULTS OF FERTILIZER EXPERIMENTS 1917 - 1935.
THE PENNSYLVANIA STATE COLLEGE

	Yields per Acre				
	SWEET CORN		TOMATOES	POTATOES	CABBAGE
	Doz.	Tons	Tons	Bushels	Tons
N	792	1.42	6.2	94	3.1
1/2 N in row	1088	2.79	9.6	141	10.2
P	867	1.67	9.5	110	8.0
1/2 P in row	927	2.08	8.2	130	8.7
K	750	1.28	6.0	90	4.0
NP	1104	2.67	12.0	128	13.3
1/2(NP) in row	1026	2.62	10.6	145	11.3
NK	993	2.09	8.0	124	7.0
1/2(NK) in row	1031	2.49	9.8	151	10.4
PK	973	2.36	12.4	167	11.6
1/2(PK) in row	892	2.11	9.4	146	9.2
NPK	1188	3.33	15.3	192	14.9
N/2 PK + N/2	1163	3.24	16.0	190	15.3
1/2(NPK) in row	1003	2.52	10.7	140	11.4
N/2 PK	892	2.21	12.9	158	11.5
NPK	1000	2.61	14.2	166	13.6
3N/2 PK	1033	2.84	13.7	171	13.2
1/2(3N/2 PK) in row	982	2.25	10.3	151	11.6
N P/2 K	942	2.33	14.1	177	10.8
NPK	1092	2.87	14.8	208	13.1
N 3P/2 K	1150	3.20	17.9	212	14.3
1/2(N 3P/2 K) in row	1052	2.66	11.7	164	12.6

TABLE I. RESULTS OF FERTILIZER EXPERIMENTS 1917-1935 - CONT'D.

	Yields per Acre				
	SWEET CORN		TOMATOES	POTATOES	CABBAGE
	Doz.	Tons	Tons	Bushels	Tons
NPK/2	1046	2.78	14.5	187	12.6
NPK	1025	2.72	14.1	191	11.4
NP 3K/2	1071	2.71	13.7	146	13.0
1/2(NP 3K/2) in row	1008	2.42	10.8	160	11.2
1/2(NPK)	971	2.54	10.7	147	9.4
3/2(NPK)	1050	2.69	14.8	179	12.7
2(NPK)	1000	2.55	15.8	154	13.8
NPK in row	996	2.64	11.2	158	12.3
SODIUM NITRATE + P	1104	2.67	12.0	128	13.3
AMMONIUM SULFATE + P	998	2.54	11.4	139	11.8
SODIUM NITRATE + PK	1225	3.36	16.9	199	14.5
AMMONIUM SULFATE + PK	883	2.27	9.9	149	10.6
DRIED BLOOD + PK	992	2.46	11.9	149	11.1
TANKAGE + PK	1000	2.48	12.6	187	11.8
CALCIUM NITRATE + PK	1233	3.43	16.0	220	14.4
CYANAMID + PK	1167	3.34	16.6	162	13.4
SUPERPHOSPHATE + NK	1208	3.26	16.8	198	14.1
BONE MEAL + NK	1192	2.91	15.5	204	11.8
ROCK PHOSPHATE + NK	1025	2.15	10.5	141	9.5
MURIATE OF POTASH + NP	1175	2.81	14.6	183	11.3
SULFATE OF POTASH + NP	1067	2.74	14.3	172	11.1
20 TONS MANURE	1181	3.64	20.4	250	14.9
30 TONS MANURE	1167	3.66	22.2	270	16.2
40 TONS MANURE	1229	3.57	22.1	250	16.9
10 TONS MANURE + NPK	1067	2.95	17.8	200	14.1
RYE & VETCH COVER + NPK	973	2.50	13.4	165	12.9

In this table, the letters, N, P, and K represent 60 lb. of nitrogen, 100 lb. of phosphoric acid (P_2O_5), and 80 lb. of potash (K_2O) per acre, from nitrate of soda, 16% superphosphate, and muriate of potash, respectively. Unless otherwise specified, the other carriers of the different plant food elements supplied the same amounts of the respective elements. All applications were broadcast by hand and harrowed into the soil before the crops were planted. Crops were grown in a four-year rotation of cabbage, potatoes, tomatoes, and sweet corn, in the order named, during the last nine years; before this, wheat followed by clover and timothy occupied the position of the sweet corn in the rotation as stated. All treatments were duplicated except the comparisons of the different plant-food carriers.

The row applications were begun five years ago, on plots which previously had been fertilized uniformly with 250 lb. of nitrate of soda and 625 lb. of 16% superphosphate per acre. In the cases in which the row applications produced a greater yield than did twice as much of the same plant food broadcast, it is likely that some of the effect is due to residual effects of this fertilization. Row applications were made in bands alongside the rows of sweet corn and potatoes; for cabbage they were mixed in the row, and for tomatoes, they were applied in a circular trench around the plant.

It may be seen that phosphoric acid is the most important plant-food element for all crops; potash is next, except with cabbage and sweet corn. The addition of each element to the other two increases the yields of all crops. Reducing the nitrogen of the standard complete fertilizer (NPK) by one-half reduced the yield of all crops, and increasing it by one-half increased the yield of sweet corn and potatoes, but reduced that of tomatoes and cabbage. All increases in the amount of phosphorus in complete fertilizers increased yields; the effects of reductions or increases in the amount of potash in the standard complete fertilizer were variable and inconsistent.

The yields on the different NPK plots vary somewhat, as might be expected. Comparisons should be made between each NPK plot and the plots under other treatment which are nearest it.

Organic nitrogen carriers are not so effective as the inorganic carriers except ammonium sulfate, for all crops; there is little difference among the inorganic nitrogen carriers, except ammonium sulfate. The effect of ammonium sulfate is difficult to understand, because in combination with superphosphate only, it is approximately as effective as nitrate of soda, but in combination with superphosphate and muriate of potash, ammonium sulfate in this experiment is less favorable to yield than is nitrate of soda. The addition of muriate of potash to ammonium sulfate and superphosphate appeared to diminish yields instead of increasing them, except with potatoes.

Bone meal is not particularly different from superphosphate, and sulfate of potash is a little less effective than is muriate, although the difference is probably insignificant.

The effectiveness of heavy applications ofmanure on all crops is very evident, though 30 tons per acre are a more effective application than are 40 tons.

Method of Application

A comparison of row applications of complete fertilizers with broadcast applications twice as great shows that in general the latter treatments produced the greater yields. The yields from the row treatments were satisfactory, however, and very likely were profitable.

In this connection, it is interesting that two separate tests in 1935 of applications in bands alongside the row, mixed with soil in the row, and broadcast with spinach, carrots, and beets, showed relative effects which were considerably different in the two tests. In the first test, made in early May on soil that was well supplied with moisture, best results were obtained from the fertilizers mixed with the soil in the row; in the second, which was made with beets only in mid July, on soil which became rather dry soon after the seed was planted, the band treatments produced best stands and yields. Evidently the condition of the soil and possibly the temperature have an influence upon the relative effectiveness of different application methods.

Rare Elements

Only a few tests of rare elements have been made at the Pennsylvania State College. Tests in 1930 with manganese sulfate on turnips and spinach showed no visible responses for these elements on the crops studied.

The relations among fertilizers, soil acidity, and treatment with potassium iodide on yield and iodine content of certain vegetables, together with the iodine content of Pennsylvania canning vegetables, were studied by Mr. Eugene P. Brasher at the Pennsylvania State College in 1931 and 1932.

The results of these studies, soon to be published in detail in the Journal of Agricultural Research, showed no consistent relationship between fertilizer treatment and iodine content of truck crops. The effects of soil acidity and treatment with potassium iodide (about 5 lb. per acre) on yield and iodine content of beans and turnips are shown in the accompanying tables.

TABLE 2. RELATION OF SOIL PH AND FERTILIZER TREATMENT TO THE IODINE CONTENT OF TRUCK CROPS.

Fertilizer Treatment Lb. per Acre	Plot	POTATOES pH of Soil	POTATOES Yield, Tons per A.	POTATOES Iodine P.P.B. Fresh Wt.	POTATOES Iodine P.P.B. Dry Wt.	TOMATOES pH of Soil	TOMATOES Yield, Tons per A	TOMATOES Iodine P.P.B. Fresh Wt.	TOMATOES Iodine P.P.B. Dry Wt.	SWEET CORN pH of Soil	SWEET CORN Yield, Tons per A.	SWEET CORN Iodine P.P.B. Fresh Wt.	SWEET CORN Iodine P.P.B. Dry Wt.
625 Super-	1-8	6.60	4.4	46	180	6.60	13.4	16	230	6.57	2.7	24	90
phosphate	4-10	6.94	3.9	48	210	6.73	10.2	8	240	5.96	3.9	25	100
167 Muriate													
of Potash	Ave	6.77	4.2	47	195	6.67	11.8	12	235	6.27	3.3	24.5	95
600 Nitrate	5-15	6.30	2.8	55	220	6.30	14.7	8	170	6.67	3.8	73	250
of Soda													
625 Super-													
phosphate													
167 Muriate of													
Potash													
400 Nitrate	1-7	6.51	2.7	60	240	7.30	11.1	19	250	6.59	2.4	37	140
of Soda													
167 Muriate	4-11	6.42	3.9	50	200	6.77	8.1	12	220	6.09	2.4	24	120
of Potash	Ave.	6.47	3.3	55	220	7.04	9.6	15.5	235	6.34	2.4	30.5	130
400 Nitrate													
of Soda	5-10	6.80	5.7	41	190	6.59	13.2	7	150	6.74	4.8	50	190
938 Super-													
phosphate													
167 Muriate													
of Potash													
400 Nitrate	1-6	6.55	4.3	51	200	7.52	17.1	14	300	5.85	3.1	33	120
of Soda													
625 Super-													
phosphate	4-12	6.66	2.9	40	150	6.87	13.8	17	370	6.68	3.8	23	90
	Ave.	6.61	3.6	45.5	175	7.20	15.5	15.5	335	6.27	3.5	28	105
400 Nitrate													
of Soda	2-12	6.55	4.5	93	410	6.28	17.5	8	160	6.73	3.2	30	100
625 Super-													
phosphate													
250 Muriate of Potash													

TABLE 3. EFFECT OF SOIL ACIDITY AND FERTILIZATION WITH Kl ON THE YIELD AND IODINE CONTENT OF BEANS AND TURNIPS.

Plot	pH of Soil: When Kl was Applied	pH of Soil: When Crop was Harvested	Beans: Yield in KGM per Plot	Beans Iodine: P.P.B. Fresh Wt.	Beans Iodine: P.P.B. Dry Wt.	Turnips: Yield in KGM per Plot	Turnips Iodine: P.P.B. Fresh Wt.	Turnips Iodine: P.P.B. Dry Wt.
1A	8.34	8.23	6.75	73	730	37.55	9496	94960
1A	8.34	8.23	8.20	26	280	32.12	79	740
2A	8.33	8.16	3.85	84	1170	27.13	5692	51470
2B	8.33	8.16	6.23	37	510	25.99	85	850
3A	7.61	7.60	2.33	71	750	22.50	2044	19540
3B	7.61	7.60	4.68	26	260	21.64	180	1590
4A	6.12	5.85	2.43	56	570	9.89	2607	24140
4B	6.12	5.85	3.58	45	490	7.71	209	2080
5A	5.92	4.95	1.21	122	1410	7.63	2148	21140
5B	5.92	4.95	4.24	54	630	7.03	191	1910

These data indicate a complex relationship in which soil acidity and the nature of the plant were conditions influencing growth and iodine content; other studies in 1933 indicated that climate or season also influenced these characteristics of the crops. The data are introduced here to illustrate the general circumstances relating to the rare elements, namely that the conditions which govern the effects of any of these substances are numerous and their relations to yield and composition of plants are complex and to a great extent unknown.

Experiments in 1937 on minor elements included a test on early cabbage of a synthetic-mineral mixture of minor elements submitted by the American Cyanamid Company, and of Soil-Aid and Garden-Aid, two mixtures submitted for test as an amendment by the Peter Manufacturing Company of Pittsburgh. The latter was applied both to early cabbage and to greenhouse cucumbers. Results of the tests are shown below.

SYNTHETIC MINERAL MIXTURE TESTS ON CABBAGE.

Plots consisted of 12 rows of 18 heads each, with 4 guard rows between plots; treatments were duplicated, and consisted of the following; Control, or 1000 lb. of 4-16-4 fertilizer broadcast; Normal Application of Minerals plus 1000 lb. of 4-16-4 fertilizer broadcast; Three Times Normal Application of Minerals plus 1000 lb. of 4-16-4 fertilizer broadcast. Results were as follows:

	CONTROL	NORMAL	3X Normal
Average yield of two plots in each treatment	194 hds. 418.5 lb.	193 hds. 456.5 lb.	183.5 hds 411. lb
Average weight per head, pounds	2.16	2.37	2.24
Percentage of plants forming heads	90	89.3	85.1

SOIL-AID AND GARDEN-AID TESTS ON CABBAGE.

Plots consisted of 6 rows of 18 plants each, with 4 guard rows between plots; treatments were duplicated, and consisted of the Soil-Aid and Garden-Aid applied according to directions, the former, 500 lb. per acre, and the latter, 6 lb. per100 sq. ft., and a control plot. Each plot except the Garden-Aid plots received sufficient ammonium sulfate, superphosphate, and muriate of potash to make the amounts of N, P, and K the same as that on the Garden-Aid plots. Results were as follows:

	CONTROL		GARDEN-AID		SOIL-AID	
Average yield per plot	79 hds.	168.5 lb.	74.5 hds.	126.9 lb.	77.5 hds.	180.1 lb.
Average weight per head, pounds	2.13		1.73		2.32	
Percentage of plants heading	87.8		82.7		86.1	

GRANULAR VS. ORDINARY COMPLETE FERTILIZERS

Tests were conducted in 1937 on spinach, early cabbage, beans, and carrots with granular and ordinary fertilizers of the same analysis. Applications were broadcast at the rate of 1000 lb. of 4-16-4 fertilizer per acre on spinach and carrots; in the row at the rate of 750 lb. of 4-16-4 fertilizer per acre on cabbage; and in a band alongside the row, at the rate of 400 lb. of 4-16-4 fertilizer per acre on beans. Treatments were in triplicate, and plots were 6 rows wide and from 140 feet with carrots to 200 feet long withbeans. Results were the following:

	ORDINARY FERTILIZER	GRANULAR FERTILIZER
Early Cabbage		
Average yield per plot	515 heads 992.4 lb.	511.3 heads 1008.4 lb.
Average weight per head, lbs.	1.93	1.97
Spinach		
Average yield per plot, pounds	71.6	69.0
Beans		
Average yield per plot, pounds	448.0	453.5
Carrots		
Average yield of roots, lb. — Marketable	4.99	4.52
Average yield of roots, lb. — Unmarketable	1.55	1.61
Total	6.54	6.13
Average weight of tops, lb.	6.39	5.84

End of Volume