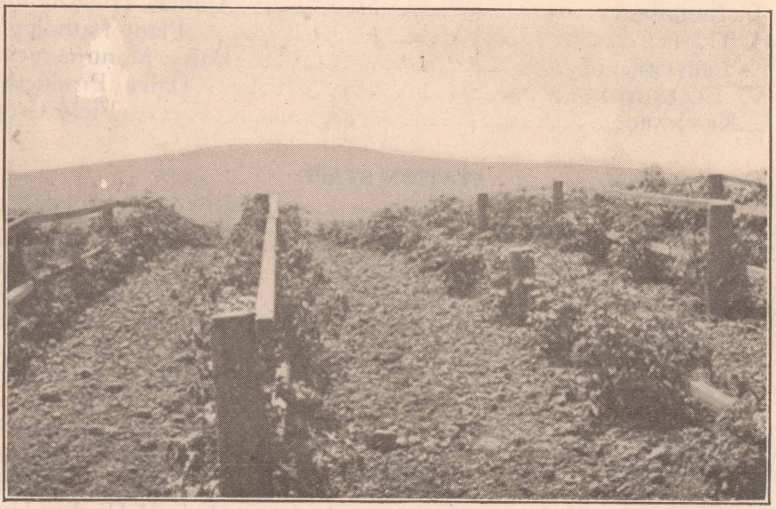
IDAHO AGRICULTURAL EXPERIMENT STATION

MOSCOW, IDAHO

DEPARTMENT OF HORTICULTURE

TOMATO CULTURE IN IDAHO



BY

W. H. WICKS

BULLETIN NO. 76 MARCH, 1913

IDAHO EXPERIMENT STATION

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The regular bulletins of this station are sent free to persons residing in Idaho who request them.

SUMMARY

This bulletin contains the results of three years' work in tomato culture at the Idaho Experiment Station 4

The demand for information received at this station regarding tomato culture indicates that the industry is developing on a commercial basis 4

In the spring of 1910 experiments in tomato culture were undertaken to secure first- hand information as to the methods of planting, cultivating, pruning, training and marketing this fruit 7

The varieties used in this experiment were Spark's Earliana, New Stone, and Dwarf Champion 8

The hotbed method of raising tomato plants is the most economical and produces satisfactory plants. The total cost of producing enough plants for one acre by this method is $9.35 13

The experiments conducted for the three years show the average cost per acre for planting tomatoes to be $7.27 24

The system of pruning used was as follows: 1, 2, and 3-stem. None of the plants were topped 24

A record of the cost of pruning and training the tomato plants was kept each year. The average cost is shown in Table 6 28

The cost per acre for staking tomato plants, including stakes and labor, is $42.57 25

The cost per acre for trellising tomato plants, including trellis material and labor is $70.58 25

That the date of maturity of marketable tomatoes has been advanced by systems of pruning and training is shown by comparing recent records with the records of previous work done at this station. Plants pruned to one stem, regardless of the systems of training, gave the greatest number of first ripe marketable fruit 29

In the matter of hastening maturity, the stake method of training is first; the trellis method of training second; and the no training third 30

The plants that received no pruning and no training on the trellis produced the highest number of boxes of all grades. The net profit of this system of training is not as great as for plants that received no pruning and no training. Table 32 51

Due to variations of soil and climatic conditions of the irrigated sections of Idaho, no rule can be laid down for the irrigation of tomatoes 42

From the records kept, it was seen that blight did not cause any noticeable loss of plants. 44-45

At present, the various kinds of tomato blights are the most serious pests that the Idaho tomato grower has to combat in some sections of the state 44

Pests and diseases which cause trouble in other states may become troublesome in Idaho when tomato culture becomes more extensive in this state 42

The first picking of marketable fruit at the station was on August 15, 1910; August 10 1911 and on September 2, 1912. Spark's Earliana gave the first ripe fruit each year .. 29

The fruit grown during this experiment was graded into fancy, second and cull grades. The cost for picking, grading and packing is given in Table 31 46

The average price received each year was as follows: 55c per box for fancy grade; 40c per box for second grade and 20c per box for culls. Each year the highest price received for fancy tomatoes was 75c; the lowest 35c 50

A record of the yield, gross and net returns for one acre, according to the different methods of pruning and training, is given in Table 32 51

INTRODUCTION

This bulletin contains the results of three years' work in tomato culture at the Idaho Experiment Station. In addition to this work at the Station tomato growers and canning companies of the state have been freely consulted. This data is incorporated with the results of our experimental work to make the information more valuable and adaptible to local conditions of Idaho.

The demand for information concerning tomato culture at this station is increasing and the writer is of the opinion that the tomato industry will develop on a commercial basis where tomato growing conditions are present. Letters received ask for information on varieties, soils, starting the plants, management of hotbeds and coldframes, methods of pruning, staking, culture, and marketing. To supply this information an experiment in tomato culture was conducted at this station.

Tomatoes are now grown commercially in parts of this state and the canning industry is developing where conditions warrant. Early tomatoes command attention only where the season is sufficiently early to compete with other early market sections.

The main crop is placed upon the market in boxes or disposed of by the ton to the canneries.

SECTIONS DEFINED*

The temperature and rainfall charts on pages 52 and 53 were drawn by Mr. Edward L. Wells, United States Weather Bureau Director, Boise, Idaho, expressly for use in this bulletin. These charts represent the most accurate drawings obtainable. The following information on sections is given in conjunction with these charts to aid in becoming familiar with congenial tomato growing conditions.

At the present time there are seven more or less prominent sections of the state quite clearly defined. These sections in the main have somewhat distinct soil features. A wider variance, however, is noted in the climatic conditions.

*Bulletin 70 Idaho Experiment Station, C. C. Vincent.

PAN-HANDLE SECTION.

The section commonly spoken of as the Pan-Handle comprises the northern part of the state, and includes all of Bonner, a large part of Kootenai, and part of Shoshone counties. This region lies to the west of the Bitter Root and Coeur d'Alene Mountains, and varies in altitude from 1000 to 4000 feet. The rainfall and temperature of this section can be determined from the charts referred to above. The climate of the Pan-Handle is mild in summer and not severe in winter, but cool nights and early fall frosts prevent tomato culture on a commercial basis. There are, however, especially protected spots where the tomato matures its fruit satisfactorily.

These areas are not sufficiently numerous to justify tomato culture on an extensive scale. The soils are of a glacial formation or lake bed deposit and vary in color from a red to a dark loam. These soils are capable of retaining an amply supply of moisture, when intensive cultivation is practised, thus eliminating the necessity of irrigation. A large portion of this region has been covered with timber and has been recently logged off.

PALOUSE SECTION.

This region includes Latah, and a section of Kootenai County, and is located in the northwestern part of the state at the base of the Pan-Handle. It has a humid climate, having an annual precipitation of twenty to thirty inches. The elevation varies from 1000 to 3000 feet. The contour of the country is rolling; the soil is of a basaltic formation, very fine in texture, and holds moisture remarkably well. The deep, moist, friable soils characteristic of this region are adapted to the growing of the tomato. The season, however, is somewhat too short, but by having plants well started in the hotbed most of the crop can be secured. Frequent cultivation during early spring and summer will aid in obtaining a satisfactory yield in this section.

LEWISTON VALLEY.

The section known as the Lewiston country comprises Nez Perce, Lewis, part of Idaho and a small portion of Latah County, being located south of the Palouse country.

The lowest point in the state is in the valley of the Clearwater at Lewiston, having an elevation of 700 to 750 feet. To the south and east of the Clearwater there is a rise in elevation, reaching an altitude of 3000 feet in some parts. The annual precipitation ranges from 12 to 20 inches. Certain parts of this country require irrigation but at the present time it is not practised to any great extent outside of the vicinity of Lewiston.

The climate and soil conditions here are especially favorable to

tomato production, many fine coves or sheltered places are found along the Clearwater and Snake Rivers for several miles south and east of the town of Lewiston. This section includes the districts of Juliaetta and Kendrick where some of our finest tomatoes are grown. The canning industry is developing here on account of the supply of good tomatoes, corn, fruit, and garden vegetables. The soil is easy to work, being of a loose, friable nature, and described as a sandy, volcanic ash of basaltic origin. It is quite rich in all the elements necessary for plant growth, the main deficiency being nitrogen which can be supplied by giving a liberal application of barnyard manure, by the growing of leguminous crops or by the use of commercial fertilizers. The latter is seldom used by tomato growers of this section.

PAYETTE VALLEY.

The Payette Valley, one of the oldest horticultural districts of the state, lies in the southwestern part of the state, near the Oregon border. The valley comprises part of Canyon and Washington Counties. The soil is a volcanic ash and varies from a light sandy soil on the upland to a heavy dark loam in the valleys. Under irrigation these soils are adapted to the growing of the tomato. Here the climatic conditions are also congenial. At the present time many small areas are being planted. The annual precipitation ranges from ten to twenty inches, hence, irrigation is necessary. The altitude is from 2000 to 3000 feet.

BOISE VALLEY.

This valley lies to the east and south of the Payette Valley, and comprises a region in the south-central part of the state. With the combination of soils, climate, and water that this region possesses the tomato can here be grown successfully. The soil is rich, being volcanic ash of a decomposed basaltic formation. Throughout the valley sandy loam soils abound. The elevation varies from 2000 to 3000 feet. The annual precipitation for this region is from ten to fifteen inches. Irrigation is depended upon.

IDAHO FALLS.

This region comprises Bonneville, Bingham, and Fremont Counties and lies in the southern and eastern part of the state. This is a comparatively new section and the tomato industry as yet is not developed. The soil is of a lava formation, sandy in nature, loose, and as a rule easy to work. This region for the most part depends upon irrigation as the annual rainfall is from ten to fifteen inches. The elevation ranges from 4000 to 6000 feet. In sections in this district where late spring or early fall frosts are not present choice tomatoes can be grown.

TWIN FALLS.

The Twin Falls country is a newly developed section which lies near the southern border. Here large areas are being reclaimed and developed for agricultural purposes. The soils are of a lava formation and sandy in nature which is characteristic of a large region in the southern part of the state. The elevation varies from 3000 to 5000 feet and has an annual rainfall from ten to fifteen inches. Under irrigation the tomato grows well in this section.

FIELD FOR THE INDUSTRY

Where tomato growing conditions can be found in this state, the industry is developing on a commercial basis. The market price for ripe tomatoes usually varies from 35c to $2.25 a box. Those sections which can produce early tomatoes find a market at prices ranging from 75c to $2.25 a box. Those sections which are so late that they cannot compete with the early districts secure from 35c to 75c per box. As a rule very few tomatoes are permitted to go to waste. When the market is slow on fancy packed tomatoes the grower can dispose of his crop to the canneries at prices ranging from $12.00 to $15.00 per ton.

As the tomato crop is an annual one and sections for its growth are more or less limited in the state it offers excellent opportunities for quick returns. It is adapted for inter-cropping in an orchard. In fact in regions where irrigation is practised and tomato blight is serious the shade and protection of the orchard seems to be beneficial.

The tomato is a standard article when canned and makes an excellent supply for a cannery in conjunction with corn, fruit, and various kinds of vegetables that thrive so well in parts of this state. Where the growing season is short, due to late spring and early fall frosts, tomato growing is not encouraged. The vines under these conditions will develop a heavy yield of fruit but they cannot mature it.

PLAN OF INVESTIGATION

In the spring of 1910, a series of experiments in tomato culture were undertaken to secure first-hand information on methods of planting, cultivating, pruning, training, and marketing. Records were carefully taken each year.

One acre of the horticultural grounds of this station was devoted

to this purpose for a period of three years. The land received no fertilizer of any kind during the period of the experiment. The acre was divided into three divisions, each division containing four plats. Division One contained plats 1, 2, 3, and 4. All plants in this division were trained on a single stake.

Division Two contained plats 5, 6, 7, and 8. All plants in this division were trained on a two-pole trellis. Division Three contained plats 9, 10, 11, and 12. Plats in this division received no supporting or staking of any kind, but were allowed to take their own method of developing on the ground.

In regard to systems of pruning the following methods were used:

Plats 1, 5, and 9 were pruned to 1 stem. Plats 2, 6, and 10 were pruned to two stems. Plats 3, 7, and 11 were pruned to three stems. Plats 4, 8, and 12 received no pruning of any kind. A plat in each division was pruned in the same manner in order to secure data on the influence of pruning when trained in three different ways. A plat in each division also received no pruning so it could be used as a check.

Division Three, which received no training served as a check to Divisions One and Two, which were trained on stakes and trellis respectively. The yield of each plat and division was carefully recorded. Each plat in each division was planted to the following varieties:

Sparks Earliana, New Stone, and Dwarf Champion.

LOCATION

This experiment was located on a southern slope of one of the hills which comprises the station gardens, a location typical of the average farm and garden land in this region. It is but a short distance to the market center of Moscow, so practically all of the product was delivered to the general market, or retailed to the citizens of the town. The area is so situated that the earliest possible cultivation in the spring is permitted. It is free from fall frost until late in September and the early part of October. No irrigation is necessary.

The desirable locations for tomato growing are to be found on the warm slopes of the rolling hills which comprise this country. Probably no location in this section is more favorably situated in respect to freedom from frost, good soil drainage, and distance from market or transportation than the area where this experiment was conducted. All these points must be carefully considered by the prospective tomato grower. If one can locate in a district where a canning

factory is established, it will be found a great aid in disposing of that part of the crop which he does not care to pack for fancy trade. (In locating for tomato growing in this state one will find, where tomatoes can be grown successfully, a considerable range in soil, site, aspect, markets, transportation, and moisture supply.)

SOIL

The tomato adapts itself quite readily to a number of different types of soil. Such factors as frost, length of growing season, altitude, sunshine and moisture supply influence the total results in tomato growing so strongly that the character of soil is to be made one of the least considerations.

The type of soil which will warm up early in spring and retain moisture reasonably well is to be preferred over those soils which are commonly spoken of as "late." Especially is this true in the non-irrigated sections where a longer growing season is desired.

PREPARATION.

The acre where this experiment was conducted was plowed in the fall and left without further working. This gave an opportunity for the soil to absorb all the moisture which fell in the form of snow or rain during the winter months. The action of frost was very beneficial in pulverizing the coarse particles and also made the soil much more friable than when plowed in the spring. Fall plowing enabled earlier discing and preparation in the spring. The soil in this section will work better in every respect under fall plowing.

When the soil dried sufficiently in the spring, it received a single discing with the disc harrow. This was done in order to break up the crust which had formed over winter and the discing aided materially in checking any loss of moisture by surface evaporation. Due to climatic conditions which prevail in the Palouse Country this first working in the spring can be done several weeks before danger of frost is over. Just before the plants were set out a double discing was given. It was gone over once with a clod crusher or planker. This put the soil in condition for receiving the plants.

SEED

The seed used in this experiment was purchased each year from the Livingstone Seed Company, Columbus, Ohio. This firm makes a specialty of handling tomato seed. It is seldom wise for the tomato

producer to grow his own seed unless he intends to select for certain characteristics which will keep up the type of the variety which he is growing or unless he is endeavoring to secure new strains.

Careful judgment should be exercised in choosing tomato seed. Good seed must be true to name, viable, pure, and be of the greatest possible longevity. Buy the best seed that the reliable seed man has to offer. Buying cheap seed is poor economy. Seed should be ordered in ample time to secure a good choice. Some growers test their seed before planting which is a very desirable practice, but a larger number of plants than necessary should always be grown to give an opportunity for selecting only strong, vigorous plants for planting.

VARIETIES

The varieties used in this experiment were Spark's Earliana, New Stone, and Dwarf Champion. It is impossible to say which variety is the best, but the Spark's Earliana gave the best results during the experiment. The tomato fluctuates rapidly according to environmental factors. This should be kept in mind at all times. Novelties are constantly appearing and disappearing. The grower must decide which are the most desirable for his use. The range of conditions found in this state has an important bearing upon the success or failure of a variety and the growing of a variety for one year is not sufficient to determine conclusively its merits or defects.

A variety test should extend over a series of years. Work at other experiment stations shows that new varieties are usually great yielders. In some cases after a few years they run out and are replaced by others. Such varieties usually run high in yield for the first few years. Examples of this performance may be illustrated by the Ignotum, Greater Baltimore and others.

COMPARISON OF VARIETIES*

The following data represents work done at this station in 1902:

The varieties used in the experiment were:

1. Dwarf Aristocrat.
2. Atlantic Prize.
3. Crimson Cushion.
4. Dwarf Champion.
5. Spark's Erliana.
6. Trucker's Favorite.
7. Fordhook Fancy.
8. Fordhook First.

*Bul. 34 Idaho Experiment Station, F. A. Huntley.

9. Ignotum.
10. Matchless.
11. Noble.
12. Peach.
13. Ponderosa.
14. Quarter Century.
15. Early Ruby.
16. Stone.
17. Sutton's Best of All.
18. Turner's Hybrid.

The descriptions following will refer to the varieties by number.

The first in earliness were, 2, 5, and 15.

The second in earliness were, 1, 3, 4, 8, 9, 16, and 17.

The intermediate in ripening were, 6, 7, and 10.

The varieties ripening very late were, 11, 12, 13, 14, and 18.

Varieties bearing small fruits were, 1, 4, 7, and 12.

The fruits of medium size were, 2, 3, 5, 6, 8, 9, 14, 15, and 17.

The large fruiting kinds were, 10, 11, 13, 16, and 18.

The warm sections of this state, where frosts are not liable to occur between the 10th of May and the middle of September, will produce any and all of these varieties with success. However, I will recommend for general culture in favorable localities numbers, 2, 5, 6, 9, 10, 11, 13, and 16.

For northern Idaho and high altitudes, where a late spring and early frosts are common, I would select numbers, 2, 4, 5, 8, and 9.

I want especially to recommend Atlantic Prize for the home garden. Spark's Earliana also proved to be a most desirable early variety. Early Ruby, Sutton's and Stone were subject to rot, a disease which attacks the blossom end about the time of ripening.

VARIETIES TESTED AT VIRGINIA STATION.

The following table, giving a list of varieties, is taken from Bulletin 8 of the Virginia Truck Experiment Station of Norfolk, Virginia. This bulletin was published May 1, 1912. While this list has not been tried in the various sections of this state it will be found useful from which to select varieties for trial.

VARIETIES GROWN AT THIS STATION.

VARIETY.	Seasons tested.	*Character of growth.	†Color of fruit.	‡Form.	First ripe fruit.	Duration of picking days.	No. of fruit per plant.	Weight of each fruit in ozs.
Acme	2	S	P	R	July 9	43	30	4.54
Atlantic Prize	2	W	R	R	July 6	44	26	3.18
Beauty	2	S	R	R	July 9	43	20	4.36
Buckeye State	2	S	P	R	July 11	41	20	5.38
Chalk's Early Jewel	1	M	R	R	June 26	42	34	2.96
Cherry	1	S	R	R	June 27	59	213	.29
Cherry	1	S	Y	R	June 22	62	351	.27
Coreless	2	S	R	R	July 19	34	17	7.40
Crimson Cushion	2	S	R	R	July 11	40	14	6.78
Dwarf Aristocrat	1	S	R	R	June 19	49	28	2.18
Dwarf Champion	2	S	P	R	June 19	39	20	2.61
Dwarf Purple	1	S	P	R	June 26	42	14	4.29
Earliana	2	M	R	R	July 6	50	18	1.96
Earlibell	2	W	R	R	June 27	47	25	2.71
Early Freedom	2	M	R	R	July 6	50	37	3.90
Early Jewel	2	S	R	R	July 19	39	24	3.90
Emperor	2	S	P	R	July 11	42	18	4.22
Favorite	2	S	R	R	June 26	42	14	4.29
Globe	1	W	P	R	June 26	42	90	1.03
Golden Ball	1	S	Y	R	June 26	42	24	2.24
Grandus	1	W	P	R	June 30	38	18	3.37
Honor Bright	1	S	R	R	June 30	38	24	4.47
Hummer	1	S	R	R	June 19	49	27	4.26
I. X. L.	1	W	P	R	June 19	48	29	4.02
June Pink	2	M	P	R	July 19	41	14	4.77
Magnitude	2	S	R	R	June 26	36	19	4.49
Magnus	2	S	P	R	June 27	45	27	4.34
Mascot	2	M	P	R	July 9	37	35	4.32
Matchless	2	S	P	I	July 9	37	35	4.32
Mikado	2	M	R	R	July 9	33	14	3.31
New Discovery	1	W	R	R	June 19	49	18	3.76
Norfolk	2	S	R	R	July 9	42	24	4.49
Peach	1	W	P	R	July 11	45	45	1.04
Pear	2	M	R	R	July 6	44	182	.35
Pear	2	S	Y	R	July 6	45	165	.38
Perfection	2	S	R	R	July 6	45	24	4.93
Plum	2	S	R	R	June 27	50	208	.55
Ponderosa	2	S	R	I	July 19	37	13	6.84
Royal Red	1	S	R	R	June 30	38	14	3.87
Stirling Castle	1	M	R	R	June 26	42	15	3.78
Stone	1	S	R	R	June 30	38	23	4.77
Tenderloin	2	M	R	R	June 30	45	24	5.72
Trophy	1	M	R	R	June 26	42	12	3.32
Yellow (Large)	2	S	Y	R	July 19	43	25	4.10

*S—strong; M—medium; W—weak.
†P—pink; R—red; Y—yellow.
‡R—regular; I—irregular.

At the present time the tomato markets in Idaho are not as exacting in their requirements as markets in sections where tomato growing is more highly developed. Our markets demand a tomato which is uniform in shape, smooth, firm, ripe, and usually the red color is preferred. For a market tomato one should choose a type of fruit which has few seeds, thick meaty cavity walls, tough skin, and runs uniform in shape and color. For canning a type should be chosen with the following characteristics:

1. Flesh firm and well formed.
2. Fruit smooth and without depressions.
3. Vine a good grower with strong stems and resistant to disease as far as possible.
4. Plant producing a large yield of fruit throughout the season.
5. Uniform red color that remains bright during the preserving process.

The Stone variety is grown considerably for canning purposes in some states and is a good variety for Idaho.

Other varieties worthy of trial are Bolgania, Royal Red, Greater Baltimore, Livingston's Globe, Field's Early June and Maul's Success. As already stated the varieties fluctuate rapidly and while these varieties are generally mentioned today for canning purposes they may not be as desirable as others in the future.

METHOD OF STARTING THE PLANTS

The hotbed was used one year in starting the plants and the green house was used the other two years. While the use of the green house facilitates the work and is the ideal way to start plants, yet equally good results may be secured by the use of a hotbed. In either method the gardener is compelled to exercise his best judgment and attention to bring out strong, thrifty plants.

The following table represents the actual expense of handling the plants by the hotbed method, but does not give the cost of equipment or interest on the investment:

COST OF PRODUCING TOMATO PLANTS FOR ONE ACRE.

Building Hotbed frame, 4 hours at 20c per hour	$ .80
Digging pit for manure, 5 hours at 20c per hour	1.00
Filling in manure, 4 hours at 20c per hour	.80
Preparation of soil, 4¾ hours at 20c per hour	.95
Planting seed, 3 hours at 20c per hour	.60
Transplanting, 16 hours at 20c per hour	3.20
Watering and Ventilating, 10 hours at 20c per hour	2.00
Total	$9.35

It required 36 hours at 20 cents per hour to pot enough plants for one acre. This expense, $7.20, should be added to the above cost when ascertaining the final cost of plants when potted plants are desired. To this also must be added the cost of the pots which in this case cost $34.00. The pots are serviceable until broken.

On March 26, 1910, the seed was sown in flats and placed in the greenhouse. Fourteen days after this the plants were pricked off to other flats. On May 17 the plants were potted into three-inch pots. They were moved to the cold frame May 24th for the purpose of hardening off preparatory to taking to the field. After all danger of killing frost, they were set in the field June 1. At this date the plants averaged from eight to ten inches high. Only healthy, stalky plants were set. Many plants at this date contained several buds. This is desirable. In 1911 the seed was planted March 21, and transplanted into three-inch pots, April 24th. They were set in the field June 1. In 1912 the seed was planted March 23, and the plants set in the field June 4.

While the above dates are satisfactory for tomato planting under Palouse conditions, they do not apply to the greater part of the state. The reader will then necessarily determine the date of the last killing frost for his locality. Do not set out tomato plants until the soil is warm and the chill is out of the air.

CONSTRUCTION OF MANURE HOTBEDS.

In making a hotbed one should be governed by the following factors:

1. Climate.
2. Location.
3. Kind of Material Used.
4. Requirement of plants.
5. Time the bed is made.

A hotbed has artificial bottom heat. This may be supplied by either fire or manure. The climate of this state and the absence of cheap fuel in some places make the fire hotbed impracticable. The manure hotbed is entirely satisfactory and can be made very cheaply by placing a sash covered frame on top of a flat pile of fermenting stable manure. This manure should be at least 2½ to 3 feet deep. This is the most common type of hotbed and is not as satisfactory as where the manure is placed in a pit.

When the sash is placed on top of the manure, it is exposed to strong winds and is more difficult to regulate the conditions in the bed. A cross section of a hotbed made by the above method is shown in Figure 1. As a rule it is more satisfactory to locate the hotbed permanently. This should be on a well drained and accessible spot, shel-

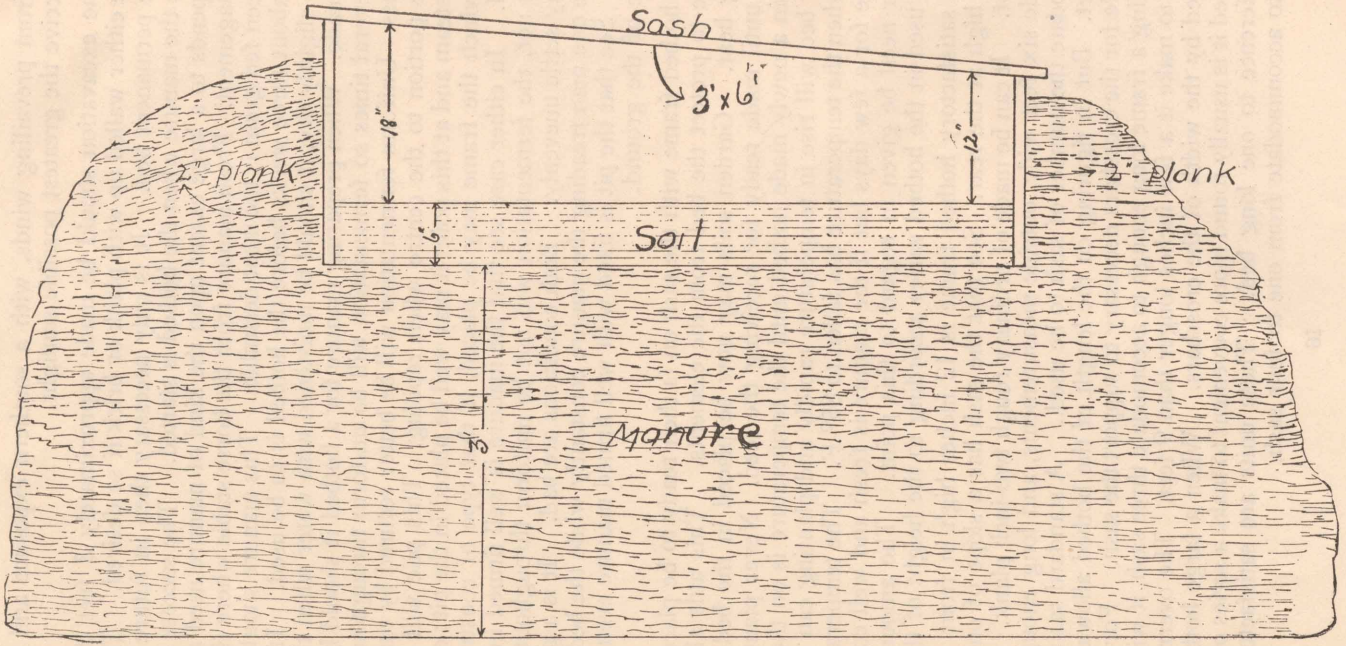

FIGURE 1. Cross-section of Manure Hotbed.

tered from prevailing winds, with a southern exposure and where it will receive the greatest possible sunlight.

The excavation should be made approximately 3 feet deep, and may be either walled up with plank or brick if so desired. This gives a more permanent bed. It is only necessary then in future years to replace the manure when the hotbed is started. The success of a hotbed depends to a large extent upon the kind of manure used and upon its management. Fresh manure from the horse stable where the horses have been fed grain is the most desirable. This manure should be prepared about three weeks before the hotbed is to be used. If the manure is slightly dry, it should be moistened with water when the pile is being made. When preparing manure for a hotbed it should be forked over several times so fermentation will be uniform throughout the entire mass. Uniform fermentation will be better secured by turning the outside portion to the centre when repiling. This pile will soon begin to steam and at this point it may well be placed in the pit; or leveled upon which the frame may be placed, if that type of construction is desired. In either case see that the manure is well firmed in the bed. If it is not, the fermentation will not be uniform throughout and the soil may settle unevenly. Both conditions are bad. It is a good plan to have one man treading the manure constantly while the bed is being made. See that the pit is filled with well firmed manure even with the surface of the ground.

The hotbed frame with the sash on is then ready to be placed on the manure to protect the bed from the elements. This aids also in retaining heat. Garden soils may now be placed in the bed and left rough until made ready for receiving the seed. Never plant seed or plants in a newly made hotbed until the temperature is on the decline. A new bed will rise in temperature rapidly and planting can safely be done when the temperature has fallen to 85° F. The temperature may not rise for a few days but if the manure is fresh and well compacted, no fear need be given in regard to this point. The amount of soil that is used in the hotbed varies according to the height of the frame.

A satisfactory hotbed frame is 12 inches high in front and 18 inches high at the rear. See that the sash has a slope of one inch to the foot. It can be made of ordinary rough two-inch plank. It should be made six feet wide, outside measurements, and long enough to accommodate the number of sash to be used.. A standard sash is 3 feet x 6 feet. But in figuring on the length of the hotbed allowance must be made for the crossbars necessary to support the sash. For instance, in making a frame long enough to accomodate three sash, it will be necessary to make it a few inches longer than 9 feet. The overrun is determined by the width of the crossbars. When a large hotbed space is needed it is usually found more convenient to make a series of hotbeds in preference to one long bed. These units are satisfactory when made to accommodate from one to four sash.

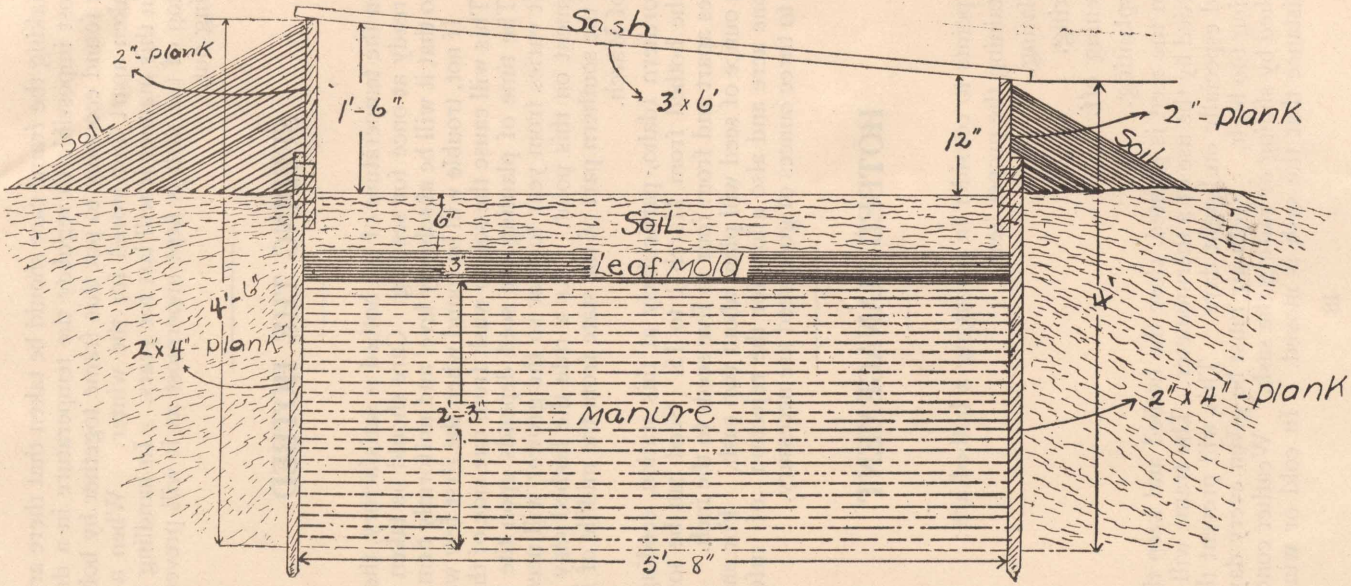

FIGURE 2. Cross-section of Manure Hotbed.

In making the frame care should be taken that there are no cracks. It is almost impossible to regulate the temperature in a drafty frame. It will be found economy to put this frame together by bolts so that it can be taken apart and stored for the winter. When a frame is handled in this manner it will last for years. In handling the sash see that the top of the sash is kept uppermost as it will prevent the glass from falling out.

SEEDING THE HOTBED

When the temperature of the hotbed is satisfactory, the soil should be made ready at once for seeding. Care should be taken in handling this soil so that it will be absolutely level and uniformly firm throughout the bed. If not, trouble will be found when the first few waterings are given. This will cause the soil to wash from one side of the bed to the other. The time of planting the seed depends upon the local conditions. It varies from year to year so the grower will need to use his best judgment on this point. As a rule the hotbed may be safely seeded in the southern part of the state from the middle of February to the first of March.

In northern Idaho, particularly at this station, seeding should be done in the hotbed from March 1 to 15. Seed can be sown in rows four inches apart and from four to five seeds to the inch. At this distanec one ounce of seed will plant about two sash. For enough plants to plant one acre and also allow for the rejection of inferior plants, from one to three ounces of good seed are necessary.

HOTBED MANAGEMENT

The points to consider in managing a hotbed are:

1. Maintaining the proper heat.
2. Ventilating.
3. Watering.
4. Hardening off.
5. Transplanting.

When the seed is planted, close the hotbed and keep the temperature recorded by the use of a thermometer. The frame will need ventilation, and especially on bright days. This will prevent the temperature running too high. Fresh air must be given every day. This is accomplished by sliding or raising the sash. Weather conditions govern the distance that the sash is moved. In cold or windy weather

the bed should be opened slightly for a few minutes two or three times a day. In changing the air of a hotbed never allow the plants to become chilled by a strong, cold wind blowing directly upon them. If the weather turns unusually cold protct the plants by covering the sash with matting made for the purpose or with heavy burlap or material of that nature. See that this covering is removed as soon as possible each morning so the plants may have the benefit of all the light. This will prevent them from growing weak and slender. There can be no best system worked out for the management of the hotbed, because of the fact that conditions vary so much and rapidly.

Experience will soon prove the best way to manage a hotbed. As a rule beginners are apt to start plants too early. A tomato plant should be stalky, strong, and vigorous when they are ready to leave the hotbed for the cold frame for the hardening off process.

TRANSPLANTING SEEDLINGS.

A new hotbed should be made ready for receiving the seedlings which should be transplanted about three weeks from the time the seed is planted. They can now stand from three to four inches apart. See that the conditions are congenial in the new bed before the transfer is made. Dig up the seedlings with as much of the roots and soil as possible. A trowel is very convenient for this. The plants are usually set with a dibber and should be placed in the ground almost to the seed leaf. Firm the soil well about the roots. This is important. Water the plants immediately after setting.

The management of this bed is practically the same as for the seed bed. The weather at this time becomes warmer so the plants may be exposed more from day to day. During the process of transplanting see that the plants are not exposed to the cold or drying winds. The amount of hotbed space for receiving the seedling will be about four times as great as the seed bed.

COLDFRAMES

A coldframe differs mainly from a hotbed in that it has no bottom heat. It should be placed near the hotbed where the same careful attention may be given. In most parts of this state sash covered with cloth may be used instead of glass. However, cloth covered sash is not as safe. It is advisable in some localities where strong winds prevail to bank up the outside of the coldframe with coarse material such as strawy manure.

TRANSFERRING PLANTS TO THE COLDFRAME.

Just before the plants begin to crowd in the second hotbed, shift them to the coldframe. The soil should be of a good composition and plants may be set in this six inches apart. This gives them room until they are transferred to the field.

The management of the coldframe differs materially from that of the hotbed. The season becomes warmer and the sash may be left en-

FIGURE 3. Potted tomato plants ready to be transplanted to the field.

tirely open the greater part of the day. However, the gardener must watch for cold, cloudy days, when the sash will need to be left on. Ventilation should be given each day. There is usually danger of a

sudden drop in temperature during the first days of spring. The grower should see that the cover of the coldframe is always put on at night during this season of the year. When danger of frost is feared, add additional cover to the frame.

HARDENING OFF THE PLANTS.

It is necessary to gradually harden off the tomato plant in the coldframe to prepare it for field conditions. If they are properly hardened and handled in transferring, they should receive no check in growth. Begin to harden the plants from two to three weeks before they are set in the field. This is done by leaving the coldframe uncovered late each day and having the sash raised to admit night air. As the nights become more congenial, the cover may be left off entirely. When thus handled they are in good condition for setting in the field.

SETTING PLANTS IN THE FIELD.

The date of setting plants in the open ground in Idaho varies greatly, due to different altitudes, kinds of soil, and climatic conditions. The plants used in this experiment were set in the field during the first week in June of each year. This date will be reasonably safe for the Palouse country. In the vicinity of Juliaetta, Lewiston, and the Snake River basin, plants can be set a few weeks earlier.

Much care should be exercised at this time to see that the root system is not molested or exposed to wind or sun while being transferred from the hotbed to the field. Where plants are grown in the hotbed, a small cube of dirt should be raised with a sharp spade. If a four-inch flower pot is used no difficulty will be experienced in molesting the root system. This latter method is recommended.

Every precaution should be made to put the field in the best condition and tilth for the reception of the plants. In the Palouse country, fall plowing of the garden ground is the most satisfactory and it should be left in the rough. The following spring as soon as it is sufficiently dry, disk thoroughly, which process will pulverize the large particles, break up the crust, and prevent loss of moisture. Several weeks may elapse between the time of the first working of the soil and the date when the danger of late-killing frost is over.

Just before setting the plants give the ground a thorough harrowing. Furrows are now made crosswise of the field by using a single shovel plow or one-horse turning plow. When furrows are made in the other direction the plants are set where they cross. The cross-furrows should not be made, however, any faster than the planting is done, as this gives plenty of loose, moist earth to be used in setting the plant. The plants in this experiment were set by hand four feet apart. The distance for planting varies with the individual grower. The

FIGURE 4. Setting plants from pots. By this method the plants receive no shock in transplanting. A much better method than shown in Figure 5.

FIGURE 5. Setting tomato plants that have not been potted. This method is very severe on the plant, and can be easily avoided by using a small pot or lifting a cube of dirt with the plant when removed from the hotbed.

average distance for planting to accommodate the nature of growth of commercial varieties is from four by five to five by five feet. Some growers recommend that the plants be set in rows four or five feet apart and the individual plants four to three feet apart in the row. It is well for the grower to plant a sufficient distance apart and have rows run straight in two directions so practically all of the cultivation can be done by horse-power.

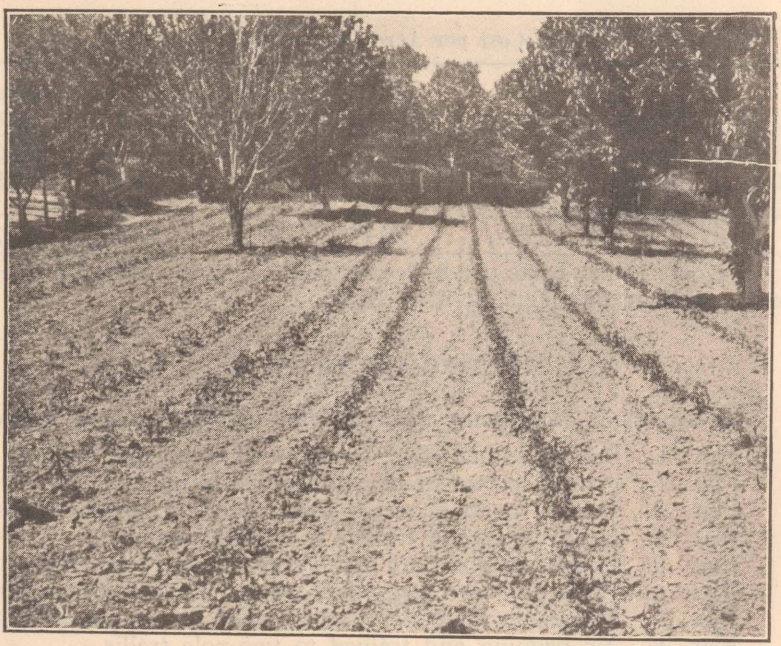

FIGURE 6. Many tomato plants are set in the orchard in the Lewiston-Clarkston district. Some growers believe that partial shade, liberal irrigation, and plenty of well-rotted stable manure placed under the roots will prevent various kinds of tomato blight.

In some of the large commercial tomato growing districts planting is done by machine. Machine planting is recommended only where a large acreage is being planted. See that the plants are set deep and firm. The size of the plant causes the depth of planting to vary, but well-grown, stocky plants should be set from five to six inches deep and firmly. Long stem plants may be set deeper.

Each year an account was kept of all expense incurred for planting one acre of tomatoes. The nature of this work and the costs of each kind is shown in Table 1. Different workmen were employed

each year and the variation in the cost of the different items is probably due to the rate which each workman performed his work, with the exception of the cost of hauling the plants in 1911. That year the plants were hauled twice the distance from the hotbed to the field. The average figures represent a more actual basis for this work than the figures for any one year. The grower will be confronted with labor problems, hence the variation in the price of the different operations may be expected to correspond quite closely to these figures.

TABLE 1—Cost per Acre for Planting Tomatoes.

	1910	1911	1912	Aver.
Marking rows	$ .95	$1.20	$ .80	$ .983
Hauling plants	1.80	2.80	1.60	2.066
Setting plants	3.65	3.45	4.50	3.866
Gathering pots in field	.35	.30	.40	.35
Total	$6.75	$7.75	$7.30	$7.265

*Note: Fifty cents per hour was paid for man and team, twenty cents per hour was paid for hand labor.

PRUNING AND TRAINING.

The methods of pruning and training employed were as follows:

Plat 1. Pruned to one stem, and trained to upright stake.
Plat 2. Pruned to two stems, and trained to upright stake.
Plat 3. Pruned to three stems and trained to upright stake.
Plat 4. No pruning and trained to upright stake.
Plat 5. Pruned to one stem and trained to two-pole trellis.
Plat 6. Pruned to two stems and trained to two-pole trellis.
Plat 7. Pruned to three stems and trained to two-pole trellis.
Plat 8. No pruning and trained to two-pole trellis.
Plat 9. Pruned to one stem and not staked.
Plat 10. Pruned to two stems and not staked.
Plat 11. Pruned to three stems and not staked.
Plat 12. Neither pruned nor staked.

In all the pruning work, the branches were removed while small by cutting them out close to the stem with a sharp knife. No topping or heading back was done on the stems that were permitted to remain. The training consisted in tying the plants securely to either the stake or the two pole trellis. Plants with more than one stem that were trained to the two pole trellis were tied in fan shape. Soft twine and raffia were used to tie the plants. Soft twine proved to be more satisfactory. Tying was done at all times before the plant was allowed to lop over.

The division which contained Plats 9, 10, 11, 12, received no stak-

ing of any kind, but Plats 9, 10, and 11 were pruned the same as the Plats in the other two divisions; namely to one, two and three stems.

FIGURE 7. Division 1, showing tomato plants trained on a single stake.

The cost of the stake and trellis material, as well as building the same, is shown in Table 2. The market price was paid for this lumber at the local lumber yard. These figures represent the total cost per acre. The entire cost for this material is listed for 1910, which makes the total expense decidedly higher than for the following two years. This material was used for three years without any apparent decay or loss except the posts, which decayed during the second year of their service. New posts were used in 1912. If the grower is so situated that he can secure small poles from the woods, the price of both stake and trellis material can be materially reduced. The stakes used in this experiment were one inch square and six feet long. The trellis material was two inches square and the pieces varied in length from 12 to 14 feet. The average cost of this material and labor in placing it is a fair basis upon which to figure during a series of years.

TABLE 2—Cost per Acre for Staking and Trellising Tomato Plants.

	1910	1911	1912
Cost of stakes	$30.75		
Cost of placing stakes	11.85	$12.81	$10.80
Cost of trellis material	48.00		
Cost of placing trellis	24.60	23.04	20.10

COST OF PRUNING AND TRAINING TOMATO PLANTS.

Each year a record was kept of the time necessary to prune and train each plant. Twenty cents an hour was paid for this labor. The pruning consisted in removing laterals that were undersirable, but no topping of the plants was done. In Plat 1, only one main vine was

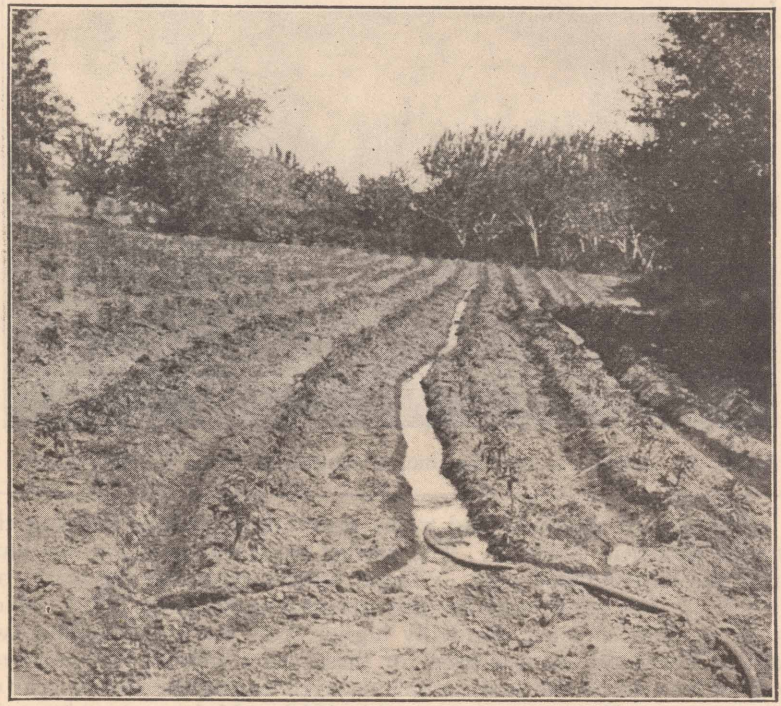

FIGURE 8. In the irrigated districts, the tomato develops a good flavor, size, color, and sweetens well before picking. Irrigate thoroly and deeply, but turn off the water when the soil is well moistened. Cultivate as soon as the soil will permit and prevent rapid evaporation.

allowed to grow, in Plat II, two main vines remained, and in Plat III, three main vines were permitted to grow. The training consisted in keeping these vines snugly tied to their support at all times during the growing period. The time required on each plat and the expense of the same is shown in Tables 3, 4, and 5. From these figures may be ascertained the cost per acre for any of the methods shown in these tables. Each Plat contained 165 plants.

TABLE 3—Cost of Pruning and Training Tomato Plants, 1910.

	Time		Cost	
	Pruning	Training	Pruning	Training
Plat 1	4.76 hrs.	4.25 hrs.	$ .95	$ .85
Plat 2	6.13 hrs.	4.08 hrs.	1.22	.82
Plat 3	8.21 hrs.	2.75 hrs.	1.64	.55
Plat 4		3.00 hrs.		.60
Plat 5	3.68 hrs.	5.75 hrs.	.74	1.15
Plat 6	5.50 hrs.	4.35 hrs.	1.10	.87
Plat 7	7.48 hrs.	4.50 hrs.	1.50	.90
Plat 8		4.31 hrs.		.86
Plat 9	3.60 hrs.		.72	
Plat 10	5.55 hrs.		1.11	
Plat 11	7.56 hrs.		1.51	
Plat 12				

TABLE 4—Cost of Pruning and Training Tomato Plants, 1911.

	Time		Cost	
	Pruning	Training	Pruning	Training
Plat 1	3.4 hrs.	5.33 hrs.	$ .68	$1.07
Plat 2	3.91 hrs.	5.58 hrs.	.78	1.12
Plat 3	3.83 hrs.	4.83 hrs.	.76	.97
Plat 4		4.91 hrs.		.98
Plat 5	2.58 hrs.	3.91 hrs.	.52	.78
Plat 6	3.33 hrs.	6.25 hrs.	.66	1.25
Plat 7	3.75 hrs.	7.08 hrs.	.75	1.42
Plat 8		7.00 hrs.		1.40
Plat 9	2.58 hrs.		.52	
Plat 10	3.08 hrs.		.62	
Plat 11	3.16 hrs.		.63	
Plat 12				

TABLE 5—Cost of Pruning and Training Tomato Plants, 1912.

	Time		Cost	
	Pruning	Training	Pruning	Training
Plat 1	6.91 hrs.	4.81 hrs.	$1.38	$ .96
Plat 2	6.67 hrs.	4.85 hrs.	1.33	.97
Plat 3	8.21 hrs.	3.80 hrs.	1.64	.76
Plat 4		11.25 hrs.		2.25
Plat 5	3.67 hrs.	4.85 hrs.	.73	.97
Plat 6	10.70 hrs.	5.32 hrs.	2.14	1.06
Plat 7	8.54 hrs.	5.80 hrs.	1.71	1.16
Plat 8		11.00 hrs.		2.20
Plat 9	4.16 hrs.		.83	
Plat 10	6.16 hrs.		1.23	
Plat 11	6.40 hrs.		1.28	
Plat 12				

TABLE 6—Average Cost of Pruning and Training Tomato Plants for 3 Years.

	Time		Cost	
	Pruning	Training	Pruning	Training
Plat 1	5.02 hrs.	4.79 hrs.	$1.00	$ .96
Plat 2	5.57 hrs.	4.83 hrs.	1.11	.97
Plat 3	6.75 hrs.	3.79 hrs.	1.35	.76
Plat 4		6.38 hrs.		1.28
Plat 5	3.31 hrs.	4.83 hrs.	.66	.97
Plat 6	6.51 hrs.	5.30 hrs.	1.30	1.06
Plat 7	6.59 hrs.	5.79 hrs.	1.32	1.16
Plat 8		7.43 hrs.		1.49
Plat 9	3.44 hrs.		.69	
Plat 10	4.93 hrs.		.99	
Plat 11	5.70 hrs.		1.14	
Plat 12				

While the figures shown in the three preceeding tables represent the cost of the pruning and training for each year, the figures found in Table 6 are more indicative of the true cost of this work. When this work is conducted over a longer period the average figures are more valuable, as minor variations are better accounted for. Table 6 shows that the expense of pruning is greater than the expense of training. Attention is also called to the fact that when training alone is done, it is more expensive than when both pruning and training are performed. This is accounted for in the fact that the workmen while pruning are also lifting the plants and tying them to their support, but in the case of training and no pruning, the plants are more difficult to handle and therefore require more time.

EFFECT OF PRUNING AND TRAINING ON DATE OF RIPENING

The popular opinion in the Palouse country is that tomatoes do not mature sufficiently early to make a profitable crop. During this work the time of maturity has been much advanced over the records found on previous work at this station. It is important in the Palouse country to select for tomatoes the warmer spots which enjoy the greatest freedom from early fall frosts. The influence of pruning and training on the date of ripening of tomato plants is shown in Table 7.

TABLE 7—Date of Picking of First Marketable Tomatoes per Plat.

Plat	Treatment	1910		1911		1912	
		Date	No. of Fruit	Date	No. of Fruit	Date	No. of Fruit
1	Pruned to one stem, on stake	Aug. 15	37	Aug. 10	71	Sept. 2	39
2	Pruned to two stems, on stake	Aug. 15	7	Aug. 10	65	Sept. 2	18
3	Pruned to three stems, on stake	Aug. 15	20	Aug. 10	46	Sept. 2	33
4	No pruning, on stake	Aug. 15	13	Aug. 10	50	Sept. 2	3
5	Pruned to one stem, on trellis	Aug. 15	63	Aug. 10	41	Sept. 2	28
6	Pruned to two stems, on trellis	Aug. 16	27	Aug. 10	41	Sept. 2	13
7	Pruned to three stems, on trellis	Aug. 16	49	Aug. 10	39	Sept. 2	19
8	No pruning, on trellis	Aug. 15	21	Aug. 10	38	Sept. 2	10
9	Pruned to one stem, on ground	Aug. 15	83	Aug. 10	36	Sept. 2	6
10	Pruned to two stems, on ground	Aug. 16	56	Aug. 10	32	Sept. 2	5
11	Pruned to three stems, on ground	Aug. 16	49	Aug. 10	43	Sept. 2	9
12	No pruning, on ground.	Aug. 16	22	Aug. 10	21	Sept. 2	2

The Earliana gave the first ripe fruit while the New Stone and Dwarf Champion varieties matured in the order given. The above table shows that the plants pruned to one stem regardless of the system of training gave the greatest number of first ripe fruit, while no definite relation is noticed in regard to the remainder of the plants in relation to pruning.

By adding the amount of first ripe fruit in each plat at the date of first picking, the conclusion is drawn that the stake method hastens maturity first, the trellis system of training second, and plants on the ground third. In comparing the different methods of training, one must consider the price of the early tomatoes and bear in mind that the tomato crop in the Palouse country starts on the seventy-five cent per box basis and rapidly falls to thirty-five cents.

EFFECT OF PRUNING AND TRAINING ON YIELD OF FRUIT

Each year during this experiment careful records were kept of the weight and number of fruit. Four grades were made, namely; fancy, second, cull, and decayed. Only perfect fruit that was mature, smooth, free from blemish, and made a uniform pack, was classed as fancy. The size varied. All tomatoes which were mature but somewhat irregular in shape with slight blemishes, were classed as second grade. This grade was entirely satisfactory for all practical uses and sold well on the local market. In fact it brought the same price as the fancy grade, but the demand was not so brisk.

In determining the yield of culls, all specimens were included that were mature but were so small or badly blemished that they could not be classed as either fancy or second grade. There was a steady demand for this class of tomato each year at one cent per pound. The decayed tomatoes consisted of all specimens that were useless for any purpose. The figures in the following tables were secured by counting the fruit and weighing in the fields at time of picking.

TABLE 8—Total Number of Fancy Tomatoes per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	423	1229	568	740
2	Pruned to two stems, on stake.....	790	1527	968	1095
3	Pruned to three stems, on stake....	1007	1369	1167	1181
4	No pruning, on stake.....	1186	1401	1552	1379
5	Pruned to one stem, on trellis.....	431	1262	770	821
6	Pruned to two stems, on trellis.....	720	1808	934	1154
7	Pruned to three stems, on trellis....	1098	1960	1365	1474
8	No pruning, on trellis.....	1602	2024	1809	1811
9	Pruned to one stem, on ground....	326	1299	428	684
10	Pruned to two stems, on ground...	510	1519	810	946
11	Pruned to three stems, on ground..	855	1418	730	1001
12	No pruning, on ground.....	1554	1577	1857	1663

TABLE 9—Total Yield of Fancy Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	178.08	384.75	227.62	263.48
2	Pruned to two stems, on stake.....	283.14	447.37	390.75	373.75
3	Pruned to three stems, on stake....	374.60	405.	410.56	396.72
4	No pruning, on stake.....	505.23	345.43	694.56	515.07
5	Pruned to one stem, on trellis.....	197.82	391.25	275.75	288.27
6	Pruned to two stems, on trellis.....	309.01	505.93	362.57	392.50
7	Pruned to three stems, on trellis...	395.28	507.	466.75	456.34
8	No pruning, on trellis.....	730.51	283.62	621.06	611.73
9	Pruned to one stem, on ground....	149.30	363.18	171.25	227.91
10	Pruned to two stems, on ground...	186.94	425.68	317.37	309.99
11	Pruned to three stems, on ground...	271.66	362.75	317.18	317.19
12	No pruning, on ground.....	557.63	423.18	580.	523.27

Table 9 shows that the average total yield in pounds of fancy tomatoes for the three years was the greatest from Plat 8, being 611.73 pounds. The plants were trained on a trellis, but no pruning was done.

TABLE 10—Total Number of Fancy Tomatoes per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	2.56	7.44	3.44	4.48
2	Pruned to two stems, on stake.....	4.78	9.25	5.86	6.63
3	Pruned to three stems, on stake....	6.10	8.29	7.07	7.15
4	No pruning, on stake.....	7.18	8.49	9.40	8.35
5	Pruned to one stem, on trellis.....	2.61	7.64	4.66	4.97
6	Pruned to two stems, on trellis.....	4.36	10.95	5.66	6.99
7	Pruned to three stems, on trellis....	6.65	11.87	8.27	8.93
8	No pruning, on trellis.....	9.70	12.26	10.96	10.97
9	Pruned to one stem, on ground.....	1.97	7.87	2.59	4.14
10	Pruned to two stems, on ground..	3.09	9.20	4.90	5.73
11	Pruned to three stems, on ground..	6.18	8.59	4.42	6.06
12	No pruning, on ground.....	9.41	9.55	11.26	10.07

The figures in Table 10 show that the smallest number of fancy tomatoes per plant for the three years came from Plat 9.

TABLE 11—Total Yield of Fancy Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	1.07	2.33	1.37	1.59
2	Pruned to two stems, on stake.....	1.71	2.71	2.36	2.26
3	Pruned to three stems, on stake....	2.27	2.45	2.48	2.40
4	No pruning, on stake.....	3.06	2.09	4.20	3.11
5	Pruned to one stem, on trellis.....	1.19	2.37	1.67	1.74
6	Pruned to two stems, on trellis....	1.87	3.06	2.19	2.37
7	Pruned to three stems, on trellis....	2.39	3.07	2.82	2.76
8	No pruning, on trellis.....	4.42	2.93	3.76	3.70
9	Pruned to one stem, on ground....	.90	2.20	1.03	1.37
10	Pruned to two stems, on ground...	1.13	2.57	1.92	1.87
11	Pruned to three stems, on ground..	1.64	2.19	1.92	1.91
12	No pruning, on ground.....	3.37	2.56	3.51	3.14

Table 11 shows that the average total yield of fancy tomatoes per plant was greatest from Plats 4, 8, and 12. In these plats no pruning was practiced.

TABLE 12—Total Number of Second Grade Tomatoes per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	1338	155	131	544
2	Pruned to two stems, on stake.....	1350	106	293	583
3	Pruned to three stems, on stake.....	1296	79	359	578
4	No pruning, on stake.....	1851	100	685	875
5	Pruned to one stem, on trellis.....	1273	92	272	545
6	Pruned to two stems, on trellis....	1632	83	364	693
7	Pruned to three stems, on trellis....	1683	145	493	773
8	No pruning, on trellis.....	2231	104	668	1001
9	Pruned to one stem, on ground....	1499	88	137	574
10	Pruned to two stems, on ground...	1898	137	286	773
11	Pruned to three stems, on ground..	1961	111	216	762
12	No pruning, on ground.....	2395	128	945	1156

Plats 4, 8, and 12 gave the largest number of second grade tomatoes per plat for the three years, as shown in Table 12.

TABLE 13—Total Yield of Second Grade Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	580.13	51	57	229.37
2	Pruned to two stems, on stake....	490.05	34	160	228.01
3	Pruned to three stems, on stake....	482.11	24	148	218.03
4	No pruning, on stake.....	788.52	22	234	348.17
5	Pruned to one stem, on trellis.....	583.38	25	94	234.12
6	Pruned to two stems, on trellis....	675.13	13	132	273.37
7	Pruned to three stems, on trellis...	653.04	41	171	288.34
8	No pruning, on trellis.....	1017.79	28	222	422.59
9	Pruned to one stem, on ground....	687.00	25	77	263.00
10	Pruned to two stems, on ground...	709.13	35	105	283.04
11	Pruned to three stems, on ground..	618.46	28	99	248.48
12	No pruning, on ground.....	855.01	32	279	388.67

In Table 13 the records show that Plats 4, 8, and 12 produced the greatest total yield of second grade tomatoes in pounds per plat.

TABLE 14—Total Number of Second Grade Tomatoes per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	8.16	.93	.79	3.29
2	Pruned to two stems, on stake.....	8.18	.64	1.77	3.53
3	Pruned to three stems, on stake....	7.85	.47	2.17	3.49
4	No pruning, on stakes.....	11.21	.60	4.15	5.32
5	Pruned to one stem, on trellis.....	7.72	.55	1.64	3.30
6	Pruned to two stems, on trellis.....	9.89	.50	2.20	4.19
7	Pruned to three stems, on trellis....	10.20	.87	2.98	4.68
8	No pruning, on trellis.....	13.52	.63	4.04	6.06
9	Pruned to one stem, on ground...	9.08	.53	.83	3.48
10	Pruned to two stems, on ground....	11.50	.83	1.73	4.68
11	Pruned to three stems, on ground..	11.88	.67	1.30	4.48
12	No pruning, on ground.....	14.51	.77	5.72	7.00

The greatest number of second grade tomatoes per plant were grown from the plants receiving no pruning and no training. See Table 14.

TABLE 15—Total Yield of Second Grade Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	3.51	.30	.34	1.38
2	Pruned to two stems, on stake.....	2.97	.20	.96	1.37
3	Pruned to three stems, on stake....	2.92	.14	.89	1.31
4	No pruning, on stake.....	4.77	.18	1.41	2.12
5	Pruned to one stem, on trellis.....	3.53	.15	.56	1.41
6	Pruned to two stems, on trellis....	4.09	.07	.80	1.65
7	Pruned to three stems, on trellis....	3.95	.24	1.03	1.74
8	No pruning, on trellis.....	6.16	.16	1.34	2.55
9	Pruned to one stem, on ground....	4.16	.15	.46	1.59
10	Pruned to two stems, on ground....	4.29	.21	.63	1.71
11	Pruned to three stems, on ground..	3.74	.16	.60	1.50
12	No pruning, on ground.....	5.18	.19	1.69	2.53

TABLE 16—Total Number of Cull Tomatoes per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	525	1066	1220	937
2	Pruned to two stems, on stake.....	578	1397	1755	1234
3	Pruned to three stems, on stake....	886	2230	2212	1776
4	No pruning, on stem.....	893	4026	3517	2812
5	Pruned to one stem, on trellis.....	667	950	1008	875
6	Pruned to two stems, on trellis....	679	1455	1572	1235
7	Pruned to three stems, on trellis...	798	1694	2158	1550
8	No pruning, on trellis.....	1108	3180	2654	2315
9	Pruned to one stem, on ground...	734	841	1142	905
10	Pruned to two stems, on ground...	811	1489	1429	1243
11	Pruned to three stems, on ground...	921	2531	1978	1810
12	No pruning, on ground.....	870	3818	5869	3519

A study of Table 16 reveals the fact that the smallest number of culls per plat for the three years were picked from the plants that were pruned to one stem. The plants pruned to two stems gave the next smallest number of culls; the ones pruned to three stems, the next smallest; while the plants receiving no pruning gave the largest number.

TABLE 17—Total Yield of Cull Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	220.60	158	376	251.53
2	Pruned to two stems, on stake....	209.81	223	482	304.93
3	Pruned to three stems, on stake...	115.10	267	618	333.36
4	No pruning, on stake.....	380.41	399	678	485.80
5	Pruned to one stem, on trellis.....	302.48	145	155	200.82
6	Pruned to two stems, on trellis....	274.99	260	281	271.99
7	Pruned to three stems, on trellis...	287.28	221	331	279.76
8	No pruning, on trellis.....	505.24	375	700	526.74
9	Pruned to one stem, on ground....	336.17	126	168	210.05
10	Pruned to two stems, on ground....	315.00	195	236	248.66
11	Pruned to three stems, on ground..	392.85	307	335	344.95
12	No pruning, on ground.....	329.15	464	754	515.71

The records as given in Table 17 show that the smallest yield of cull tomatoes in pounds per plat for the three years were produced in plats 1, 5, and 9.

TABLE 18—Total Number of Cull Tomatoes per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	3.18	6.46	7.39	5.67
2	Pruned to two stems, on stake.....	3.50	8.46	1.06	4.34
3	Pruned to three stems, on stake.....	5.36	13.51	13.40	10.75
4	No pruning, on stake.....	5.41	24.40	21.31	17.04
5	Pruned to one stem, on trellis.....	4.04	5.75	6.10	5.29
6	Pruned to two stems, on trellis....	4.11	8.81	9.52	7.48
7	Pruned to three stems, on trellis....	4.83	10.26	13.07	9.38
8	No pruning, on trellis.....	6.71	19.27	16.08	14.02
9	Pruned to one stem, on ground....	4.44	5.09	6.92	5.48
10	Pruned to two stems, on ground...	4.91	9.02	8.66	7.53
11	Pruned to three stems, on ground...	5.58	15.33	11.98	10.96
12	No pruning, on ground.....	5.27	23.13	35.56	21.32

In Table 18 the greatest number of cull tomatoes per plant are shown to have been grown in Plats 4, 8, and 12.

TABLE 19—Total Yield of Cull Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	1.33	.95	2.27	1.51
2	Pruned to two stems, on stake.....	1.27	1.35	2.92	1.84
3	Pruned to three stems, on stake...	.69	1.61	3.74	2.01
4	No pruning, on stake.....	2.30	2.41	4.10	2.93
5	Pruned to one stem, on trellis.....	1.83	.87	.93	1.21
6	Pruned to two stems, on trellis....	1.66	1.57	1.70	1.64
7	Pruned to three stems, on trellis....	1.74	1.33	2.00	1.69
8	No pruning, on trellis.....	3.06	2.27	4.24	3.19
9	Pruned to one stem, on ground....	2.03	.76	1.01	1.26
10	Pruned to two stems, on ground....	1.90	1.18	1.43	1.50
11	Pruned to three stems, on ground...	2.38	1.86	2.03	2.09
12	No pruning, on ground.....	1.99	2.81	4.56	3.12

Table 19 shows that the smallest number of cull tomatoes in pounds per plant were picked from Plat 5.

TABLE 20—Total Number of Decayed Tomatoes per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	331	146	898	458
2	Pruned to two stems, on stake.....	199	215	1291	568
3	Pruned to three stems, on stake.....	342	245	1152	579
4	No pruning, on stake.....	490	356	1395	747
5	Pruned to one stem, on trellis.....	165	115	687	322
6	Pruned to two stems, on trellis....	252	232	925	469
7	Pruned to three stems, on trellis...	406	144	723	424
8	No pruning, on trellis.....	452	258	844	518
9	Pruned to one stem, on ground....	171	223	580	324
10	Pruned to two stems, on ground....	228	381	675	428
11	Pruned to three stems, on ground...	377	288	839	501
12	No pruning, on ground.....	484	396	1743	784

Where the system of no training and no pruning was resorted to, the average total number of decayed tomatoes per plat was 784. Less rot was detected where the tomatoes were trained on the trellis and pruned to one stem. See Table 20.

TABLE 21—Total Yield of Decayed Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	139.35	35	187	120.45
2	Pruned to two stems, on stake.....	72.23	60	247	126.41
3	Pruned to three stems, on stake.....	126.22	46	252	147.40
4	No pruning, on stake.....	188.31	60	236	161.43
5	Pruned to one stem, on trellis....	75.74	38	203	105.58
6	Pruned to two stems, on trellis....	102.06	50	227	126.35
7	Pruned to three stems, on trellis....	146.16	35	299	160.05
8	No pruning, on trellis.....	206.11	44	177	142.37
9	Pruned to one stem, on ground....	78.31	56	134	89.43
10	Pruned to two stems, on ground..	83.90	85	204	124.30
11	Pruned to three stems, on ground..	144.86	61	207	137.62
12	No pruning, on ground.....	172.76	62	356	196.92

The total yield of decayed tomatoes in pounds per plat is given in Table 21. The figures in this table and in Table 22, which gives the total number of decayed tomatoes per plant, emphasize the facts brought out by Table 20.

A comparison of Tables 20 and 21 shows that both the number of decayed tomatoes per plat and the yield of decayed tomatoes in pounds per plat was less by the trellis method of training than that from the other two methods.

TABLE 22—Total Number of Decayed Tomatoes per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	2.00	.88	5.44	2.77
2	Pruned to two stems, on stake.....	1.20	1.30	7.82	3.44
3	Pruned to three stems, on stake....	2.07	1.48	6.98	3.51
4	No pruning, on stake.....	2.96	2.15	8.45	4.52
5	Pruned to one stem, on trellis.....	1.00	.69	4.16	1.95
6	Pruned to two stems, on trellis....	1.52	1.40	5.60	2.84
7	Pruned to three stems, on trellis....	4.27	.87	4.38	3.17
8	No pruning, on trellis.....	2.73	1.56	5.11	3.13
9	Pruned to one stem, on ground.....	1.03	1.35	3.51	1.96
10	Pruned to two stems, on ground....	1.38	2.30	4.09	2.59
11	Pruned to three stems, on ground..	2.28	1.74	5.08	3.03
12	No pruning, on ground.....	2.93	2.40	10.56	5.29

TABLE 23—Total Yield of Decayed Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	.84	.02	1.13	.66
2	Pruned to two stems, on stake.....	.43	.03	1.49	.65
3	Pruned to three stakes, on stake....	.76	.02	1.52	.76
4	No pruning, on stake.....	1.14	.03	1.43	.86
5	Pruned to one stem, on trellis.....	.45	.02	1.23	.58
6	Pruned to two stems, on trellis....	.61	.03	1.37	.67
7	Pruned to three stems, on trellis....	.88	.02	1.81	.90
8	No pruning, on trellis.....	1.24	.02	1.07	.77
9	Pruned to one stem, on ground....	.47	.03	.81	.43
10	Pruned to two stems, on ground..	.50	.05	1.23	.59
11	Pruned to three stems, on ground..	.87	.03	1.25	.71
12	No pruning, on ground.....	1.04	.03	2.15	1.07

A study of Table 23 shows that the plants pruned to one stem on the ground gave .43 pounds of decayed tomatoes per plant as an average for the three years, as compared to 1.07 pounds per plant picked from the plants receiving no pruning and no training.

TABLE 24—Total Number of Tomatoes per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	2354	2614	2817	2595
2	Pruned to two stems, on stake....	2917	3245	4307	3489
3	Pruned to three stems, on stake....	3531	3923	4890	4114
4	No pruning, on stake.....	4420	5883	6441	5581
5	Pruned to one stem, on trellis.....	2536	2419	2737	2564
6	Pruned to twe stems, on trellis.....	3283	2802	3795	3293
7	Pruned to three stems, on trellis....	3985	3943	4914	4280
8	No pruning, on trellis.....	5393	5566	5649	5536
9	Pruned to one stem, on ground...	3129	2451	2180	2586
10	Pruned to two stems, on ground...	3447	3500	3200	3382
11	Pruned to three stems, on ground..	4114	3332	3425	3623
12	No pruning, on ground.....	5303	5919	9547	6923

The figures shown in Table 24 represent the total number of tomatoes, regardless of the grade which each plat produced during the three years of this experiment.

TABLE 25—Total Yield of Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to 1 stem, on stake....	650.50	621.25	649.00	640.25
2	Pruned to 2 stems, on stake....	665.00	759.75	1086.00	836.91
3	Pruned to 3 stems, on stake....	715.00	744.00	1158.00	872.33
4	No pruning, on stake.....	892.50	844.75	1789.25	1175.50
5	Pruned to 1 stem, on trellis....	631.50	583.50	731.00	648.66
6	Pruned to 2 stems, on trellis....	728.50	813.00	902.50	814.66
7	Pruned to 3 stems, on trellis....	885.00	832.50	1264.50	994.00
8	No pruning, on trellis.....	968.00	810.25	1720.50	1166.24
9	Pruned to 1 stem, on ground...	696.50	663.75	548.75	636.33
10	Pruned to 2 stems, on ground..	777.50	743.00	842.45	787.74
11	Pruned to 3 stems, on ground...	890.00	744.25	757.00	797.08
12	No pruning, on ground.....	1010.50	965.00	1968.00	1314.50

The figures shown in Table 25 represent the total yield of tomatoes regardless of the grade which each plat produced during the three years of this experiment.

Of the three methods of training, little variance is noted in the total yield of tomatoes in pounds per plat between the trellis, stake and ground systems for the plants pruned to one stem.

TABLE 26—Total Yield of Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	3.94	3.76	3.93	3.87
2	Pruned to two stems, on stake.....	4.03	4.60	6.58	5.07
3	Pruned to three stems, on stake....	4.83	4.50	7.01	5.28
4	No pruning, on stake.....	5.45	5.11	10.84	7.13
5	Pruned to one stem, on trellis.....	3.82	3.53	4.43	3.93
6	Pruned to two stems, on trellis.....	4.41	4.92	5.46	4.93
7	Pruned to three stems, on trellis...	5.36	5.04	7.66	6.02
8	No pruning, on trellis.....	5.86	4.91	10.42	7.06
9	Pruned to one stem, on ground....	4.22	4.02	3.32	3.85
10	Pruned to two stems, on ground....	4.71	4.50	5.10	4.77
11	Pruned to three stems, on ground...	5.39	4.51	4.58	4.82
12	No pruning, on ground.....	6.12	5.84	11.92	7.96

Table 26 shows the total yield of tomatoes in pounds per plant, regardless of the grade.

TABLE 27—Total Yield of Marketable Tomatoes in Pounds per Plat.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to 1 stem, on stake.....	978.81	593.75	660.62	744.39
2	Pruned to 2 stems, on stake....	983.00	704.37	1032.75	906.70
3	Pruned to 3 stems, on stake....	971.81	696.00	1176.56	948.12
4	No pruning, on stake.....	1674.16	766.43	1606.56	1349.06
5	Pruned to 1 stem, on trellis....	1083.68	561.25	524.75	723.22
6	Pruned to 2 stems, on trellis....	1259.13	778.93	775.57	937.87
7	Pruned to 3 stems, on trellis....	1335.60	769.00	968.75	1024.45
8	No pruning on trellis.....	2253.54	886.62	1543.06	1561.07
9	Pruned to 1 stem, on ground...	1172.47	514.18	416.25	700.96
10	Pruned to 2 stems, on ground...	1211.07	655.68	658.37	973.70
11	Pruned to 3 stems, on ground...	1282.97	697.75	751.18	912.63
12	No pruning, on ground.....	1741.79	919.18	1613.00	1424.65

Compare the total yield of marketable tomatoes in pounds secured from Plat 8, where no pruning was done and the plants were trained to the trellis, to the yield of Plat 12, where no pruning and no training was done.

TABLE 28—Total Yield of Marketable Tomatoes in Pounds per Plant.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	5.93	3.59	4.00	4.50
2	Pruned to two stems, on stake.....	5.95	4.26	6.25	5.48
3	Pruned to three stems, on stake....	5.88	4.21	7.13	5.74
4	No pruning, on stake.....	10.14	4.64	9.73	8.17
5	Pruned to one stem, on trellis.....	6.56	3.40	3.18	4.38
6	Pruned to two stems, on trellis....	7.63	4.72	4.70	5.68
7	Pruned to three stems, on trellis....	8.09	4.66	5.87	6.20
8	No pruning, on trellis.....	13.65	5.37	9.35	9.45
9	Pruned to one stem, on ground.....	7.10	3.11	2.52	4.26
10	Pruned to two stems, on ground..	7.33	3.97	3.99	5.09
11	Pruned to three stems, on ground..	7.77	4.22	4.55	5.51
12	No pruning, on ground.....	10.55	5.57	9.77	8.63

In compiling the data for Tables 27 and 28, only marketable specimens were included. In order to ascertain what proportion of this yield is fancy, second, or cull, see previous tables listing the total yield in pounds per plat for each grade.

The following table is composed of the figures secured from all plats, regardless of either pruning or staking. It represents for each grade the yield in pounds of marketable tomatoes for each year.

TABLE 29—Total Yield of Marketable Tomatoes in Pounds per Acre.

Fancy			Second		
1910	1911	1912	1910	1911	1912
4139.20	5045.14	4835.42	8139.75	358.00	1778.00

TABLE 29—(Continued)

Culls			Total		
1910	1911	1912	1910	1911	1912
3669.08	3140.00	5114.00	15948.03	8543.14	11727.42

CULTIVATION

Begin cultivation as soon as the plants are set. This loosens the soil, and forms a dust mulch. See that this mulch is maintained throughout the growing period. It prevents evaporation of moisture from the soil. The first few cultivations may be made deep and reasonably near the plant, but later cultivation should be sufficiently shallow so that none of the root system will be molested. In the non-irrigated sections cultivation should be given every ten days or two weeks and after a rain. In the irrigated sections the cultivation should be given just as soon as the ground is sufficiently dry after each irrigation.

Cultivation in this manner will prevent the appearance of weeds and time spent in thorough cultivation will be amply repaid. When the fruit begins to ripen, cultivation should cease almost entirely. Two or three cultivations during the ripening period will enlarge the yield. It should be done with care, as the root system can be easily injured. Injury at this time is serious. A one-horse cultivator of the Iron Age or Planet Junior type is a very good tool for doing this work.

The cultivation each year in this experiment was done with a one-horse Iron Age cultivator. This work was paid for at the rate of thirty cents per hour including time for man and horse. The hand cultivation consisted in removing what weeds the cultivator was unable to destroy. The following represents the cost of cultivation for the acre each year.

For 1910 the horse cultivation was $2.55. The hand cultivation was seventy-four cents. In 1911 the horse cultivation was $3.00,

while the hand cultivation was seventy-eight cents. In 1912 the horse cultivation was $2.33 and the hand cultivation was sixty-seven cents.

IRRIGATION

Due to variation of soil and climatic conditions of the irrigated sections of this state no rule can be laid down for the irrigation of tomatoes.

See that the newly set plants have one good application of water which is sufficient to moisten the soil at the greatest depth possible.

Begin cultivation immediately and at all times endeavor to preserve moisture in order to lessen the number of irrigations. Under ordinary conditions possibly three irrigations would be sufficient but the grower must necessarily determine this for himself after the study of his soil and the behavior of his plants. As a rule when the fruit begins to mature more water will be needed than in the earlier life of the plant. Some growers, especially in the vicinity of the Lewiston, Idaho and Clarkston, Washington have found that a liberal application of well-rotted horse manure placed under the plant when set out and followed thruout the entire season with sufficient irrigations will prevent quite noticeably the attacks of various tomato blights.

INSECTS AND DISEASES*

The tomato industry in Idaho is still in its infancy. The insects and diseases which are troublesome in other states may be found in this state when tomato growing becomes more extensive. At the present time, no reports have come to this station of serious damage done by insects. However, it is always well for the grower to be on the lookout for these. The damage done each year by various kinds of bacteria and fungi is so great that tomato growing has been abandoned in some sections. Some years the entire crop is lost. The following represents the most important tomato insects and diseases:

TOMATO WORM—This is a large, greenish worm which lives upon the foliage. It is a ravenous feeder and can destroy a vine quickly. It can be controlled by the use of arsenate of lead or Paris green. Hand picking is economical when they occur in small numbers.

STALK BORER—This insect enters the stalk and causes it to suddenly wilt and even die by making tunnels thru the plant. The

*When unknown insects or diseases appear send specimens to the Department of Botany or Etomology for identification and control.

insect or its effect is not difficult to locate. Preventive methods should be used in its control. Cleanliness of the plantation and rotation of crops is recommended.

CUT WORMS—There are several kinds of cut worms which may destroy tomato plants. These worms eat off the plant close to the ground especially when the plant is first set. Poison bait, made of bran, molasses, and Paris green, may be effectually used against this insect. In the evening place the bait about the plant as most of the cut worms feed at night and conceal themselves in the ground during the day.

BLOSSOM END ROT—This occurs at the blossom end of the fruit, and spreads until in some cases the entire specimen is lost. It attacks the green fruit. When the disease does not spread through the specimen it may ripen and the unaffected portion be usuable. From the work of various experiment stations and reports from the tomato growers of this state the best method for controlling or preventing this trouble is to keep an abundant supply of water in the soil at all times. The disease seems to thrive best on light soil and during dry weather. See Figure 10.

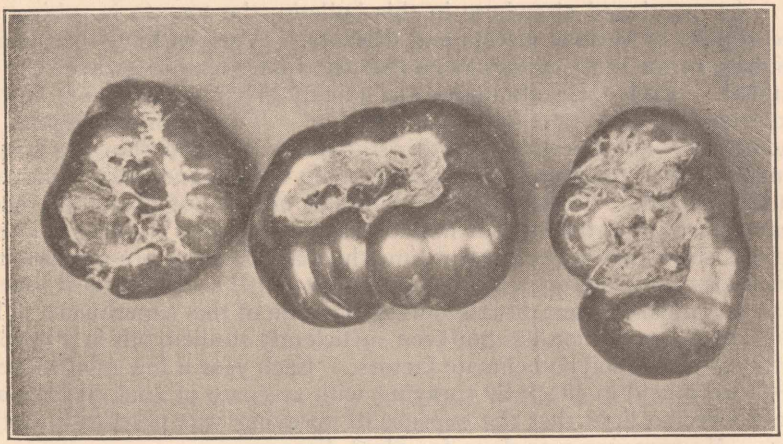

FIGURE 9. Blossom End Root of the tomato. This trouble caused most of the decayed specimens in this experiment. For full discussion see Bulletin 96, Georgia Experiment Station; Bulletin 95, University of Tennessee, and Bulletin 153, South Carolina Experiment Station.

LEAF SPOT DISEASES—There are several kinds of leaf spots affecting the tomato plants. These occur at small, irregular areas and may be brownish, black or purple in color. As a rule they affect

the lower leaves first and in severe cases defoliate the entire plant. These diseases can be controlled by spraying with Bordeaux Mixture, made by the standard formula: four pounds Copper Sulphate, four pounds lime, fifty gallons water. The leaf spot diseases which are caused by a fungus should not be confused with bacterial diseases.

TOMATO WILT—This has been found to be a bacteria. It enters the leaves and stops up the water carrying vessels of the stem. The plant soon begins to wilt and die. It appears first at the tips of the branches. It soon spreads from branch to branch until the entire part is affected. Upon cutting into an affected stem, a brown streak is noticeable just beneath the bark which extends lengthwise of the stem. Leaf eating insects carry the bacteria from plant to plant. It is also carried over in the soil from year to year. Usually only a few plants are affected the first season the trouble appears. It becomes more prevalent when tomatoes are grown for a number of years upon the same soil. At present the only known method of controlling it is to destroy infested specimens as soon as they appear. Prevent inoculation of the uninfested ground and practice rotation of crops. As this same disease attacks potatoes and eggplant do not use them in the rotation.

As mentioned elsewhere in this bulletin, the tomato is subject to the attacks of various insects and diseases. Various kinds of tomato blights are the most serious pests that the Idaho tomato grower has to combat. Each year attention was quickly given to all plants in the experiments showing any sign of disease. The definite fungous or bacteria was not ascertained in this study, but all plants showing symptoms of either fungous or bacterial trouble were immediately removed and destroyed. Table 30 shows the total number of plants lost each year according to the various methods of pruning and training. These figures show that at the present time the plant diseases are not causing much loss in tomato growing at this station. 1911 was the most severe year in regard to plant disease during the time of this experiment. The cause of this condition has not been sufficiently studied, but in all probability is due to soil and climate factors. Each year a few minor insect pests were held in check by spraying with arsenate of lead, but the attacks were so light that the expense of spraying was practically nothing. No spraying was done for plant diseases.

TABLE 30—Total Number of Blighted Tomato Plants for Three Years.

Plat	Treatment	1910	1911	1912	Aver.
1	Pruned to one stem, on stake.....	9	11	9	9
2	Pruned to two stems, on stake.....	5	14	2	7
3	Pruned to three stems, on stake....	6	14	0	6
4	No pruning, on stake.....	5	16	4	8
5	Pruned to one stem, on trellis.....	12	12	2	8
6	Pruned to two stems, on trellis....	10	11	3	8
7	Pruned to three stems, on trellis...	5	9	5	6
8	No pruning, on trellis.....	11	22	5	12
9	Pruned to one stem, on ground....	7	21	5	11
10	Pruned to two stems, on ground....	8	10	0	6
11	Pruned to three stems, on ground...	4	15	2	7
12	No pruning, on ground.....	5	13	2	6

HARVESTING

The time of harvesting the tomato in Idaho, either for market or for the canning factory, depends upon the locality in which they are grown. At this station the first picking of marketable fruit was August 15, 1910, August 10, 1911, and September 2, 1912. Spark's Earliana gave the first ripe fruit each year.

PICKING

The first ripe fruit in 1910 was picked August 15. The picking of the last ripe marketable fruit for this year was October 12. The picking of the first ripe fruit in 1911 was August 10, and the last ripe marketable fruit was picked October 3. The first ripe fruit in 1912 was picked September 2, the last ripe marketable fruit was picked October 26. During each year a few green tomatoes were sold after the dates given above. The first killing fall frost which destroyed the tomato vines and stopped the marketing of ripe fruit occcured September 25, 1910; September 24, 1911 on the low ground and October 16, 1911 on the high ground; and October 7, 1912.

Only ripe fruit should be picked when it is to be sold on the local market. For shipping it must be picked much greener, as it ripens in transit. Over-ripe or "leaking" tomatoes cannot be handled profitably. This will necessitate frequent gathering, and all plants

should receive equal attention, in order to prevent some fruit from becoming over-ripe.

The tomato must be carefully picked. It is very easily bruised and a picking basket lined with some soft material like burlap may be found convenient. There are many styles of picking utensils on the market. One will have no difficulty in choosing a satisfactory type.

Tomatoes collect considerable dust while growing. If spraying has been done for disease or insect pest it also is noticeable. Therefore, every fruit should be carefully wiped. This can be conveniently done just before they are placed on the packing table.

The following table represents the total cost to pick, grade and pack tomatoes from each division.

TABLE 31—Cost for Picking, Grading and Packing Tomatoes.

How trained.	Time.		
	1910	1911	1912
Division 1. On stakes.....	18.25 hrs.	33.00 hrs.	49.83 hrs.
Division 2. On trellis.....	15.30 hrs.	43.66 hrs.	51.58 hrs.
Division 3. On ground.....	15.30 hrs.	31.41 hrs.	53.00 hrs.

TABLE 31—(Continued)

How trained.	Cost.			Average Total cost
	1910	1911	1912	
Division 1. On stakes.....	$ 3.65	$ 6.60	$ 9.97	$ 8.74
Division 2. On trellis.....	3.06	8.73	10.32	7.37
Division 3. On ground.....	3.06	6.28	10.60	6.64

Each division received the same pruning. These figures show that the average cost of harvesting is greatest when plants are supported by a single stake. The lowest cost is for plants not supported.

A division is one-third of an acre. From these figures may be determined the cost per acre for picking, grading, and packing tomatoes, when trained by the above methods.

GRADING

Before placing the tomato upon the market have it carefully graded. The system of grading adopted in this experiment was as follows:

Fancy, second, and culls. Accuracy in grading pays well on any market. In this way a reputation can be secured and maintained.

The tomato that is sound, smooth, regular in shape, free from cracks and blemishes, is packed as fancy. Second grade tomatoes consist of those specimens which are slightly inferior to the fancy grade in smoothness, size or extent of cracks, but ripe and make a uniform pack. All rough, over-ripe, cracked, or unsightly specimens are classed as culls.

PACKING

The Western Standard tomato box is made in two sizes—length 18½ inches; width, 11½ inches; depth, 3½ inches. The other size is length, 18½ inches; width 11½ inches; depth, 4 inches. This box is used both for local market and export. A careful packer will see that no package leaves the field defective in regard to quality of pack, name of variety, and any labelling that the grower is using to establish his reputation. As a rule, the market demands that this style of package be only for the fancy and second grade.

In some markets, principally in the Middle West, the four-basket crate is used. This is especially preferable for fancy, early tomatoes. The dimensions of this crate are 22 inches x 13 inches x 4⅜, and contains four baskets, each one being 10 inches x 6¼ inches at the top, 8½ inches x 4¾ inches at the bottom, and 4 inches deep. This is the standard package for tomatoes produced in Southern Illinois.*

Thruout the Boston market district the favorite package for tomatoes is the Boston bushel box. While there are some districts in this state able to produce a fancy early tomato, the type of container is governed by the demand of the market. As most of the fruit is consumed in local markets, probably there will be no change from our present package.

For canning purposes some canneries prefer to furnish the crates to the grower. These crates hold about fifty pounds and are constructed to prevent any injury to the fruit. No crate of tomatoes should be delivered to the canning factory in a dripping or otherwise defective condition, as only choice fruit will produce the first grade canned product .

MARKETING

The fruit from this experiment was sold each year on the local market in Moscow. Due to our environment, the crop begins to ripen

*Illinois Experiment Station Bulletin No. 144, p 85.

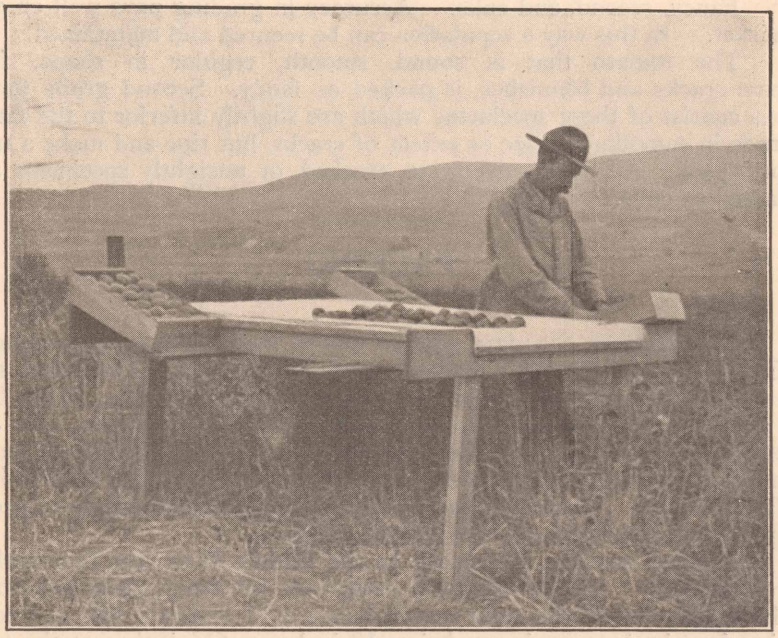

FIGURE 10. A convenient table for packing tomatoes. Is is three feet high, three feet wide, and four feet long, the top is made of canvass. Four packers can work at this table.

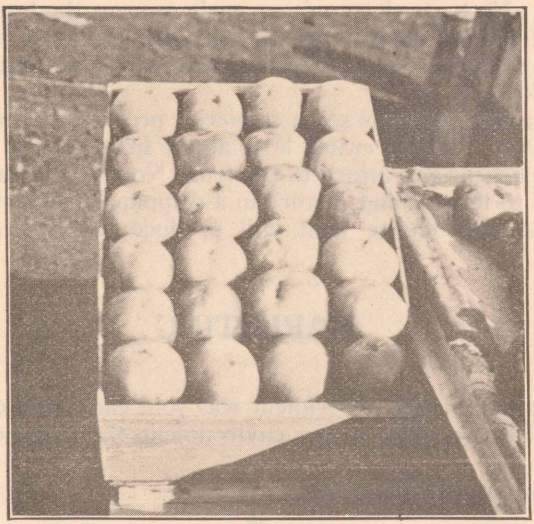

FIGURE 11. A box of fancy tomatoes, as graded in this experiment. Note the style of pack and type of box.

when the price of tomatoes is rapidly falling. This is caused by our market having received several weeks previous fancy tomatoes from early districts, such as Juliaetta, Lewiston and early districts in the neighboring state of Washington.

Each year our fancy tomatoes started on our local market at 75 cents per box. This price ruled for seven or eight days. It then fell quite systematically 10 cents a box per week until it reached 35 cents. The bulk of the crop has been moved at an average price of 55 cents.

In the extra early districts the fruit usually starts on the market in the neighborhood of $2.00 per box, and gradually decreases until the bottom price of 35 cents is reached.

Before such prices are reached, however, most growers prefer to sell their crop to the canning factory at prices ranging from $10.00 to $15.00 per ton.

The prospective tomato grower should ascertain his market before planting extensively. A few tomato growers can supply the local market in towns averaging from four to five thousand people, but in localities where a cannery is in operation the fruit can be disposed of at a profit first to the fancy trade and then to the cannery. This outlet is very satisfactory. Practically all of the canneries in this state are unable to get enough tomatoes.

At the present time the Idaho markets are not as exacting in the type of tomato as older tomato markets are. The Chicago market, for instance, prefers tomatoes primarily of two kinds: All tomatoes, regardless of the variety, that are smooth, large and with purple or pink color are classed as "Acme" type. While those tomatoes which are bright red or scarlet and more or less wrinkled or irregular are classed as the "Trophy" type. In recent years, however, improved varieties have been brought out, that resemble the Acme type in color, but the Trophy type in shape. This has led to such confusion that there is a tendency to handle the tomato on the market under the variety named. For the present the Idaho market demands a tomato which is smooth, ripe, well colored, and free from blemish. As the industry increases and the market requirements become more defined, the grower will be compelled to ascertain which type his market demands and then cater to this desire.

YIELDS

In a good season with proper care of vines and without exceptional loss from disease or insect attacks, the yield may be expected to run from five to twelve tons per acre. Occasionally a good tomato grower secures even a higher yield than this.

A study of the tabulated statement of yields will show the amount of fruit secured in this experiment for each year and by various sys-

tems of pruning and training. It is assumed that the commercial tomato grower will fertilize his ground each year, with well rotted stable manure or its equivalent. This should increase his yield each year very materially. No fertilizer was used in this experiment. The tomato responds readily to fertilization. An excess of nitrogen causes a rank growth of the plant at the expense of the fruit. A study of the amount of fruit and vine on each plant will aid the grower in the question of handling the fertilization.

PROFITS

Table 32 shows the total gross returns, the total cost of production and the estimated net profits of tomato growing per acre.

In compiling the figures of the following table, a record of the tomatoes gathered each year was taken for each grade. Only marketable fruit was considered. The record of yield in boxes represents the performance record of each plat. In order to reduce this to an acre basis, the average yield per plant was taken for each grade and for each plat and this average was multiplied by the number of plants per acre, which in this case were set four feet apart, and therefore, an acre would contain 2722 plants. The total gross returns are determined for each grade according to the average price received per box, this being 55 cents for fancy; 40 cents for second; and 20 cents for culls. The total gross returns are determined by adding the amount received for all grades. In determining the total cost of production per acre, all expenses, which were incurred during the year for each method of growing were added together. The net profit per acre is secured by subtracting the total cost of production from the total gross returns. While the net profit figures are purely an estimate on the acre basis, yet they are based upon facts and figures secured for each plat during the experiment, and are therefore, reasonably authentic. Table 32 shows that the highest net profit may be expected from plants which receive no pruning and no training. The fact is, however, that the plants which received no pruning, but trained on the trellis, produced more boxes of all grades than the plants handled in any other way, but the cost of the trellis material lowered the net profit per acre. This table also shows that in every case the yield and net profit per acre is the smallest when plants are pruned to one stem, and it increases in both yield and profit, regardless of the method of training, when pruning is not performed.

TABLE 32—Showing Yield, and Gross and Net Returns from One Acre of Tomatoes.

	Yield in Boxes.			Gross Returns.			Total Gross Returns	Total Cost of Production	Net Profit
	Fancy	Second	Cull	Fancy	Second	Cull			
Pruned to one stem, on stake.....	216.39	187.81	205.51	$119.01	$ 75.12	$41.10	$235.23	$128.56	$ 96.67
Pruned to two stems, on stake....	307.58	186.45	250.42	169.17	74.58	50.08	293.83	144.14	149.69
Pruned to three stems on stake....	326.64	178.29	273.56	179.65	71.32	54.71	305.68	144.83	160.85
No pruning, on stake.....	423.27	288.53	398.77	232.80	115.41	79.85	427.96	113.85	314.11
Pruned to one stem, on trellis....	236.81	191.90	164.68	130.25	76.76	32.94	239.95	166.66	73.29
Pruned to two stems, on trellis....	322.55	224.56	223.20	177.40	89.82	44.64	311.86	174.53	137.33
Pruned to three stems, on trellis..	375.63	236.81	230.00	206.60	94.72	46.00	347.32	178.55	168.77
No pruning, on trellis.....	503.57	347.05	434.5	276.96	138.82	86.83	502.61	191.90	310.71
Pruned to one stem, on ground..	186.45	216.39	171.48	102.55	86.56	34.30	223.41	92.62	130.79
Pruned to two stems, on ground..	254.00	232.73	203.65	139.70	93.09	40.70	273.52	97.96	175.56
Pruned to three stems, on ground.	259.95	204.15	259.44	142.97	81.66	51.89	276.52	96.73	179.79
No pruning, on ground.....	427.35	344.33	424.63	235.04	137.73	84.93	457.70	114.07	343.63

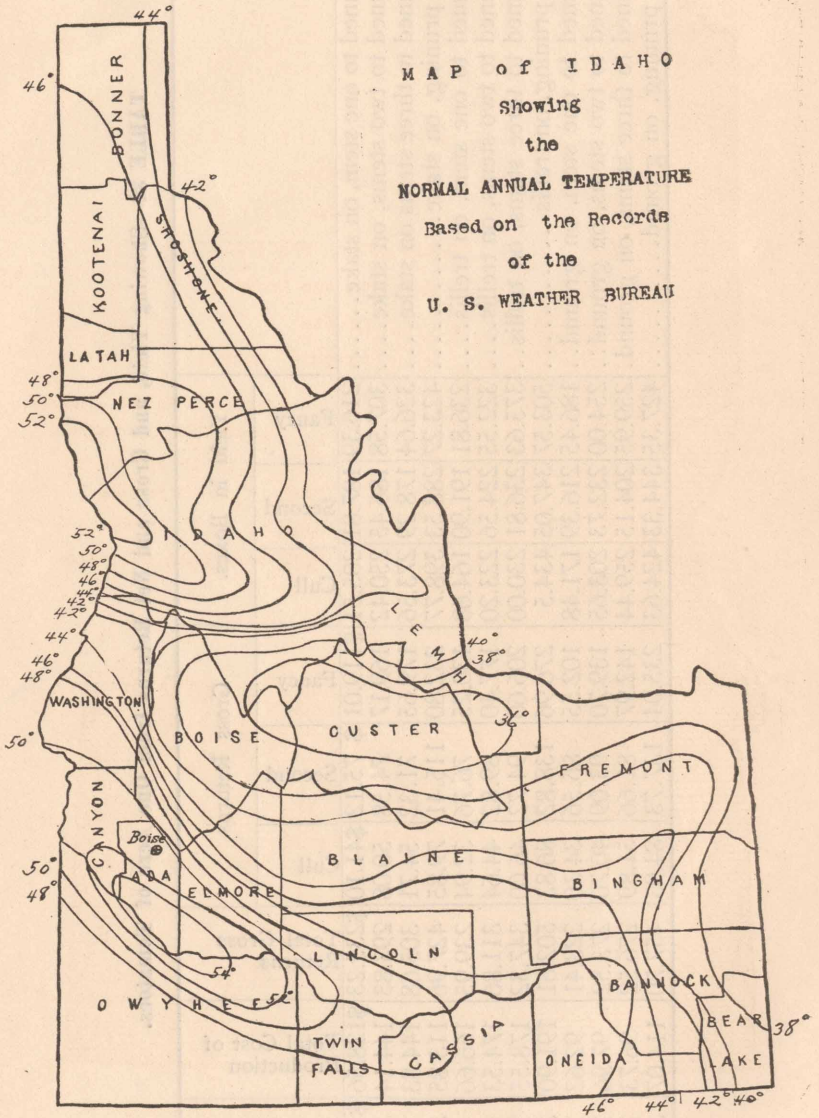

FIGURE 12. Temperature Chart of the State of Idaho.

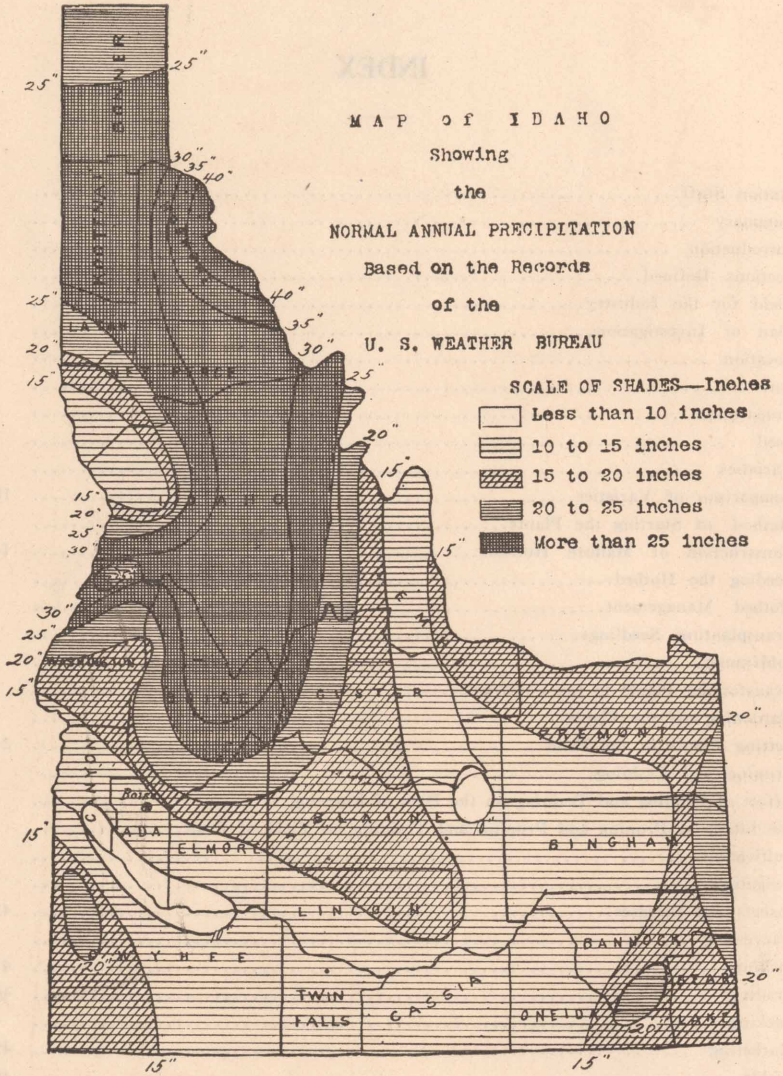

FIGURE 13. Rainfall Chart of the State of Idaho.

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