University of the State of Missouri.

COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

Agricultural Experiment Station.

BULLETIN NO. 43.

I. Winter Forcing of Asparagus in the Open Field.

II. Asparagus Culture for Missouri.

COLUMBIA, MISSOURI.

May, 1898.

E. W. STEPHENS, Printer, Columbia, Missouri.

University of the State of Missouri.

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Winter Forcing of Asparagus in the Open Field.

By J. C. WHITTEN, Horticulturist.

SUMMARY OF RESULTS.

I. Asparagus may be profitably forced in the open field in midwinter, in this climate, by running steam into shallow tunnels between the asparagus rows, as described on p. 56.

II. The steam, coming in direct contact with the soil, readily penetrates it, heating the whole bed uniformly; whereas if the tunnels are heated by inclosed steam or hot water pipes, the soil becomes too hot and dry close to the tunnels while it is too cold midway between them.

III. Forcing steam into the tunnels keeps the soil moist and maintains more continuous fermentation of the manure mulch, thus promoting steady heat.

IV. The asparagus produced in this way was larger, of finer quality, and the bed produced longer, than that forced by any other method tried.

V. The plants thus forced recuperate by being allowed to grow one summer without cutting, while asparagus plants transplanted for forcing are ruined by the process.

VI. The amount of soft coal used to force a plot of asparagus, 25 by 25 feet, in this way, from December 29 to February 25 (58 days) was 2,308 pounds, costing $1.82, or an average of 39 pounds daily.

VII. During these 58 days, steam was turned into the six tunnels of this plot a total of 16¼ hours, equivalent to 17 minutes daily, or less than three minutes daily for each tunnel.

VIII. The forced asparagus yielded, during the 58 days, at the rate of 9882 bunches, or 4,880 pounds per acre.

IX. About five minutes at a time is as long as steam can be forced into a tunnel without danger of overheating the asparagus.

GENERAL STATEMENT.

Asparagus is frequently forced, out of season, by transplanting the roots to a warm place. Perhaps the most common method is to take mature roots from the field and plant them under green house benches, where the space would not otherwise be used. Sometimes forcing houses or low frames with sash are made especially for this purpose. Since direct sunlight is not required asparagus is also forced in cellars, pits or in almost any place where there is sufficient warmth.

Forcing these transplanted roots is, however, a very wasteful process, as the plants are exhausted by it and are unfit for further use. Plants are seldom strong enough for forcing before they are four years old, consequently producing them is expensive.

Various methods of forcing asparagus in the open field have from time to time been tried. Barrels without heads have been placed over the plants, warmed by partly filling and banking up with fermenting manure and the stems thus forced into growth within the barrels. Frames, covered with sash, are sometimes placed over the rows of plants for winter forcing. In this latitude, good asparagus has been secured in winter by packing heating horse manure in trenches between the rows to supply the necessary heat. In European gardens brick tunnels are sometimes made between the rows of asparagus in the field. Hot water pipes within these tunnels furnish the heat for winter forcing. In his Forcing Book, Professor Bailey describes a unique scheme for forcing asparagus in the open field by covering it, in winter, with a movable roof of muslin, supported by a frame of steam pipes, and heating this portable forcing house with steam, conducted through a regular system

of steam pipes. In spring the roof is removed and the asparagus finds itself growing out of doors.

Forcing asparagus, where it is grown in the field, has a two-fold advantage over removing the roots to a warm place. *First*, it saves the trouble and expense of transplanting them, which must be done with much care; and *second*, it saves the plants from being ruined by the forcing process. Plants forced in the field, where they grow, will, if given good care, entirely regain their vigor in a season or two and may be used again for forcing. By this latter method a better quality and a larger quantity of marketable asparagus is also usually secured.

FORCING ASPARAGUS BY STEAM AT THIS STATION.

Forcing asparagus in winter is somewhat expensive. From the above account it will be seen that the methods generally employed entail considerable labor and expense. For this reason it is not generally forced except on a small scale. In November, 1896, this station undertook some experiments, with the hope of simplifying the winter forcing of asparagus in the field. The idea was to do away with the necessity of piping the bed, by blowing steam, for a few minutes daily, directly into tunnels between the rows of plants, and retaining this heat by liberal mulching. This work was undertaken by Mr. Joseph Ambs, the station gardener, to whose careful methods the success of the experiment is largely due.

Preparation of the Field for Forcing.—The field selected for the experiment was planted to asparagus about ten years ago. The plants were in fair vigor, though of a small variety. The first section forced embraced six rows, four feet apart and fifty feet long. Fig. 1 shows this section with one tunnel uncovered. Trenches were first made between the rows. This was done by plowing between them, twice in a place, throwing the furrows on the plants so as to cover each row with two furrows of loose earth. These trenches between the rows were then made uniform by means of the spade. When finished they were three or four inches lower than the crowns of aspar-

Fig. 1.—Showing construction of tunnels between the rows for forcing steam through the soil.

agus in the adjacent rows. These trenches were then covered with twelve inch boards, which rested on four inch blocks, placed at frequent intervals along either side of the trenches. This formed tunnels between the rows for conducting the steam. To guard against the steam's escaping, two or three inches of soil was placed over the boards, and the asparagus patch was then covered with five or six inches of horse manure. This covering was to prevent the heat from escaping from the soil too rapidly. It was then ready for the steam to be turned into the tunnels.

The Steam Connection.—To conduct the steam a one and one half inch pipe was carried above ground from the boiler to one end of the central tunnel, a distance of 185 feet. A steam hose long enough to reach each tunnel was attached to this pipe through which to blow steam into the tunnels. It was not the idea to give a constant supply of steam, but to discharge a little into the tunnels each afternoon, or as often as was necessary to maintain sufficient warmth. A piece of tile was inserted into the mouth of each tunnel to prevent the discharging steam from tearing away the earth.

Steaming the Soil.—The first steam was turned into the tunnels on November 14, 1896. Steam was discharged into each tunnel, not to exceed five minutes at a time, in order not to heat the earth too hot in any single place. It required about one hour of steaming the first day to bring the bed up to the required temperature of sixty degrees. The distribution of heat throughout the bed was very uniform and satisfactory. The moist steam seemed to permeate the soil equally in all directions.

After the first day, very little steaming was necessary until the asparagus began to be produced. On an average the bed was steamed about twice in three days and then only for about five minutes for each tunnel. The soil and horse manure mulch seemed to hold the heat very well, the frequent steamings keeping up fermentation in the mulch.

The first asparagus was cut November 24, ten days after the first steam was applied. The stems were cut just before

they got through the soil and were perfectly bleached. They were as large as those ordinarily produced during the normal period of growth in spring, and were far more crisp and delicious.

Cuttings of asparagus were made almost daily for about a month, when the growth became somewhat weak. The last cutting was made on December 22. During the month 141 bunches of the ordinary market size and weighing about one half pound each were cut from this bed of 25x50 feet. This was equivalent to 300 feet of row or 100 hills of asparagus.

The second asparagus bed was managed the same as the first. It was first steamed on December 16, 1896, and the first asparagus was cut on December 30. The weather was much colder at this time and a little more steam was required. At times, however, no steam was applied for two or three days, and the temperature of the bed did not fall much below sixty degrees. The finest asparagus was produced during the coldest weather. The time of cutting, however, was slightly more irregular than in the previous bed, and was prolonged until February 26, 1897. The bed was 25x75 feet, or equivalent to a row 450 feet long. It produced 234 market bunches besides considerable that was taken for exhibition purposes. Fig. 2 shows a jar of the asparagus grown in January, when the thermometer was often below zero.

At this writing, May 2, 1898, the spring growth of asparagus from the beds forced during the winter of 1896–7, shows that one season's growth, after forcing, is sufficient for the plants to regain their normal vigor.

Experiments During the Winter of 1897–8. — This method of forcing asparagus by steam proved so successful that it was determined during the winter of 1897–8, to ascertain as nearly as possible, the amount of coal necessary for forcing a given area, and the value of the product.

A plat twenty-five feet square was prepared in December for forcing. It contained six rows twenty-five feet long, or the equivalent of one row 150 feet long. After making the tunnels

between the rows, the bed was covered with six or eight inches of fresh horse manure. Mr. N. O. Booth, Assistant in Horticulture, and Mr. W. L. Howard, a student, who evinced much interest in the experiment, took charge of the work and kept the records of results.

The steam was furnished by the boiler used in heating our greenhouses and hotbeds. The fuel used was our native soft coal, costing, delivered, six and one half cents per bushel of eighty pounds, or $1.62 per ton.

To ascertain the amount of coal used for forcing the asparagus, the heat was turned off the remainder of our plant whenever the asparagus bed was being steamed. Midday, during bright sunlight (when the sun heat was sufficient to maintain enough warmth in the

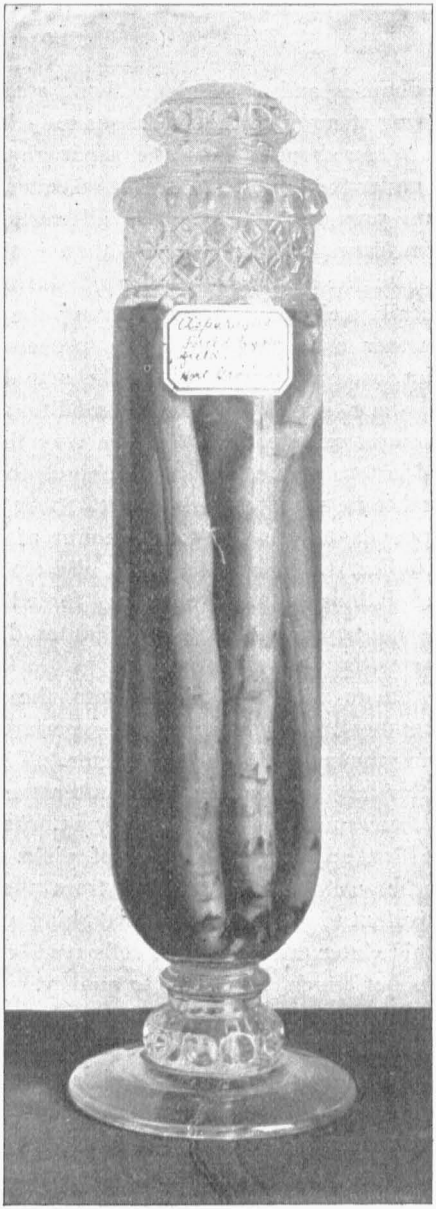

Fig. 2.—Showing specimens of asparagus forced in the open field in January, temperature about zero. Sprouts twelve inches long and about one inch in diameter,

greenhouses and hotbeds without steam), was selected for blowing steam into the asparagus tunnels.

When about to heat the asparagus, the condition of the fire under the boiler, the height of water in the gauge and the steam pressure, if any, were all carefully noted. With all steam turned off, pressure was then gotten up to about thirty pounds; the amount of coal used during the steaming being carefully weighed. After steaming the asparagus the amount of water exhausted during the process was replaced in the boiler, account being taken of the actual quantity, and the fire and steam gotten up to the conditions existing before the asparagus was steamed. In this way the total amount of coal used in forcing the bed of asparagus for fifty-eight days was found to be 2,308 pounds (worth $1.82), or the equivalent of 39 pounds daily. The total amount of water exhausted from the boiler, during the steaming, was 1,087 gallons; equivalent to 18 gallons daily. Steam was forced into the bed a total of 16¼ hours, equivalent to 17 minutes daily, or less than three minutes daily for each tunnel.

Steam was first turned into the asparagus tunnels on December 29, in order that the experiment might be conducted during the cold days of midwinter. The first asparagus was cut January 12, fourteen days after the first steaming. The last asparagus was cut February 25, fifty-eight days after heat was first applied. The rate of yield of asparagus was 162 bunches weighing 80 pounds, from the plot 25 feet square, equivalent to 9,882 bunches, weighing 4,880 pounds per acre. In midwinter this asparagus sells readily at from ten to twenty cents per bunch, according to quality.

Exhausting steam into the asparagus bed, instead of returning it to the boiler in an inclosed circuit, would at first, seem to be a wasteful process of heating. Experiment showed, however, that the circumstances justified this method. Heating a bed of this kind by a circuit of steam pipes or hot water pipes is very unsatisfactory. The heat from pipes very soon dries out the soil, around the tunnels, destroying its power to conduct heat. In this way the bed becomes too hot and dry

adjacent to the tunnels, and too cold a short distance from them. It also becomes necessary to maintain heat in the pipes a good part of the time.

By blowing steam directly into the tunnels the soil is kept moist; the steam has a penetrating effect, and permeates all parts of the bed, giving a uniform heat throughout; this moist steam keeps up a continual fermentation of the manure mulch, thus giving heat and only occasional brief steamings are necessary.

Care must be taken not to use too much steam at one time, or the plants may be ruined by over heating. Our asparagus rows were four feet apart, the tunnels midway between them were only eight inches wide, and yet we found that five minutes at a time was as long as was safe to force steam into a single tunnel.

These experiments have been so successful as to indicate that any one, provided with a steam heating plant could successfully force asparagus for the markets in this manner.

To still further test forcing asparagus by steam, in the open field, we are now growing a field of asparagus in which four inch drain tiles have been placed one foot below the surface, in such a way that we expect to use them for underdrainage, for sub-irrigation and for steaming the asparagus for winter forcing.

II. GENERAL.

ASPARAGUS CULTURE.

Asparagus is one of our finest garden vegetables, and merits much more extended culture. It may be grown by simple and inexpensive methods and should take a prominent position in the home garden as well as in the market garden. Its extreme earliness, appearing in this latitude in early April, when spring vegetables are most welcome, is alone sufficient to recommend it to every garden. As ordinarily grown on the farm it is too troublesome and expensive of culture and too

poor in quality to deserve much appreciation. It is often planted irregularly in beds, so that horse cultivation is impossible, and expensive hand hoeing and weeding is necessary. Worse yet, it grows in many gardens in sod, and the sprouts are so small and tough as to be almost worthless.

The soil selected for the asparagus bed should, if best results are expected, be a rich, loose, deep, friable loam. A liberal admixture of sand is desirable. It will do well, how-however, in almost any good soil. The lighter and dryer the soil, the earlier the sprouts may be obtained in spring.

Prepare the ground by previous clean culture to hoed crops, and liberally enrich it. Stable manure is best and too much can not be used so long as it is properly incorporated in the soil. Plow deeply, and subsoil if the nature of the land renders it advisable.

The plants for setting should not be more than one year old. If properly grown they will be as large as is desirable to move. Ordinarily the seeds are sown in early spring two or three inches apart, in rows far enough apart for easy cultivation. The plants are cultivated and hoed throughout the summer, and are ready for transplanting to their permanent position the next spring. These are termed nursery grown plants.

We have found that it is much better to plant the seeds in six inches of rich sandy soil, in the greenhouse, or hot bed, in February or early March. Sow liberally, for seven-eighths of the seedlings should be discarded. When the seedlings are three inches high, select those which have the thickest, fleshiest and most numerous stems, and pot them. They vary more than almost any other vegetable. Many that appear large and vigorous will have broad, flat, twisted or corrugated stems. Discard them. Beware, also, of those that put out leaves close to the soil. These will all make tough, stringy, undesirable plants. The best plants are those which are cylindrical, smooth, and free from ridges. They shoot up rapidly, and attain a height of two inches before leaves are put out. They look much like smooth needles. This matter of selecting the

best plants for potting, and subsequent planting out, is of the greatest importance in asparagus culture.

These young plants should first be put in small pots and moved into larger ones as soon as they are well rooted. They may need to be shifted twice before they are planted out of doors, which should be done when danger of frost is over.

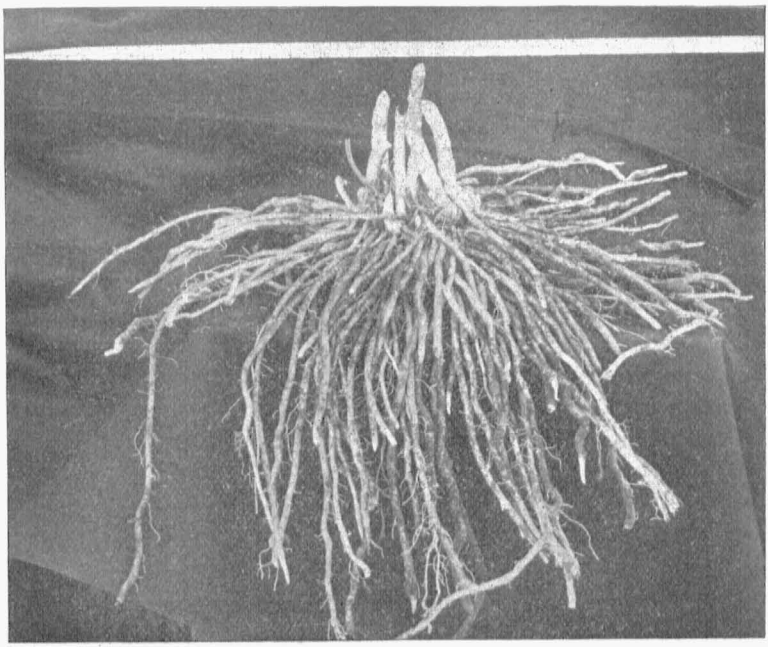

Fig. 3.—One year old asparagus plant. Started in greenhouse in February, and transplanted to the field May 1.

Started in this way they continue to grow from the time they are planted out and reach very large size the first season. In the case of nursery grown plants, where seeds are sown directly out of doors the young seedlings start very slowly, are very tender during their early growth, and if the weather is unfavorable they hardly become well established before autumn. Fig.

3 shows a one year old plant, started in February in the greenhouse, and transplanted to the field the first of May. Our plants grown in this way reach as good size in one year as the nursery grown plants usually do in three years.

Setting the plants in their permanent position should be done in spring. If the plants are nursery grown, from seed, sown out of doors, without transplanting, they should be set in early spring, as soon as the soil can be worked to good advantage. If the seeds were started under glass in February, they should be planted out the last of April or first of May.

The crowns should be set from four to eight inches deep, the depth depending upon whether the soil is light or heavy, and upon how early the growth is desired in spring. The deeper they are set, the later they will start in spring.

The distance apart should be about eighteen inches in rows four feet apart. Rows should run north and south, to readily admit the sunlight.

Cultivation should be clean and thorough throughout the summer. Keep the cultivator going to prevent the formation of a crust on the soil, after a rain, and to retain the moisture. Work the earth toward, rather than away from the plants.

In early winter take off the old stems and give a liberal dressing of old, fine manure. Most writers advise applying this dressing during the growing season, when the plants can use it. In our soil better results are obtained by applying it in winter. It prevents the soil from running together and hardening, and also prevents the sprouts from coming through, as they otherwise often do, too early in spring, and becoming weakened by subsequent severe freezing.

As early in spring as the ground can be worked, it should be plowed between the rows, turning the land onto the plants, and leaving a dead-furrow between the rows. This ridges the land as seen in Fig. 4. If bleached asparagus is desired, these ridges over the plants should be about a foot higher than the bottom of the dead-furrow between the rows. If the asparagus is cut as soon as the sprouts come through these

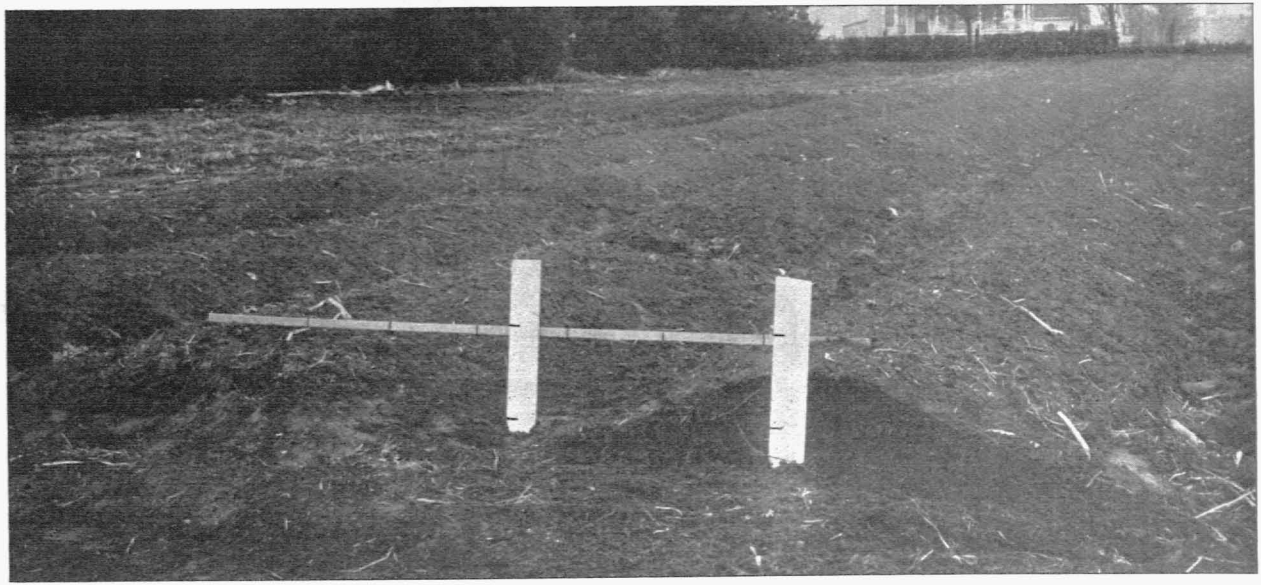

Fig. 4.—Asparagus field properly ridged in the early spring. Ridges about one foot high.

ridges, it will be white, crisp and tender. Some, however, prefer the stronger flavor acquired after the sprouts have taken on their green color in the sunlight. If the green color is desired the ridges may be left lower and the asparagus allowed to grow several inches above ground before cutting.

The cost of cultivation is much less where the ridges are maintained along the rows. They may be turned up with the plow and cultivated with a light toothed cultivator or harrow. The ridges may be made much smoother and more symmetrical with a garden rake but it is more expensive. Whichever implement is used the ridges should be stirred immediately after the asparagus has been cut, so that the growing sprouts will be below ground, safe from injury. After cutting ceases and the plants are allowed to make their summer's growth they will quickly shade the rows sufficiently to keep down nearly all weed growth, except what can be killed with a cultivator. Rightly managed very little hand hoeing is necessary.

Cutting the asparagus should not begin until the plants have become strong and vigorous, which takes two or three years from the time of planting. In this latitude the asparagus begins producing in early April, and cuttings may be continued, if the growth is strong, until June. After cutting has begun, all sprouts should be cut every day. If any stems are allowed to grow and make leaves, the young sprouts cease to appear. For this reason the cuttings should be clean until they cease altogether for the season. The earlier cutting is stopped and the earlier plants are allowed to make their summer's growth, the stronger the plants will become.

The sprouts should be tied in neat bunches for market. These bunches are usully made about four inches in diameter. The sprouts are made of uniform length by cutting off the bases of the bunches, after they are tied.

The best fertilizer is stable manure. A great many advise the use of salt. About the only advantage we have derived from its use is that of killing the weeds without injuring the asparagus. It may be applied in sufficient quantity to injure

the asparagus, but applied in moderate quantities it checks weed growth without injuring, or so far as we can see, benefiting the asparagus itself. If a commercial fertilizer is to be used nitrate of soda or ground bone are good. Too much care can not be taken to keep the plants well fed and well cultivated during summer after cutting ceases, as upon this growth depends the strength of the plant for producing the next spring's crop. Never cut off the stems until they are killed by the frost.

The most popular varieties are Conover's Colossal and Palmetto.

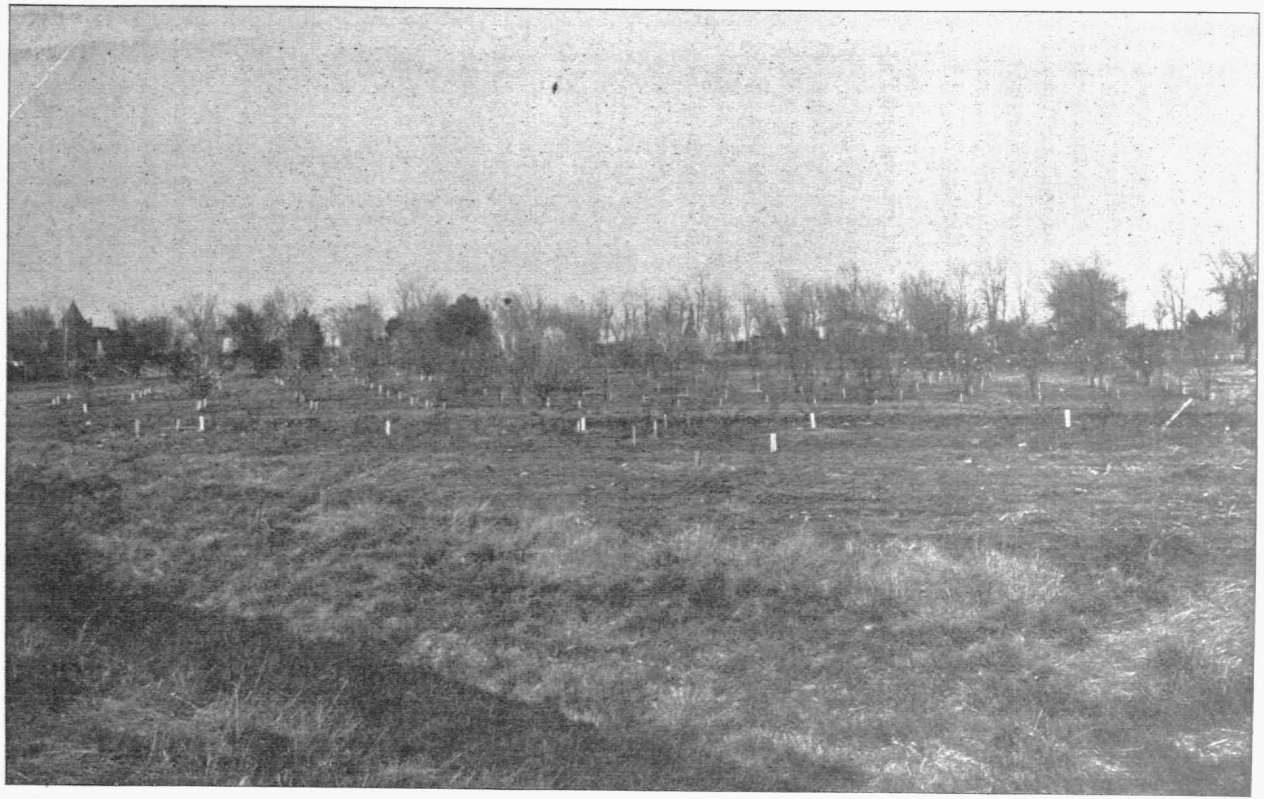

Fig. 5.—A section of the Horticultural grounds showing a portion of the orchard experiments.