THESIS

FORCING GARDEN CROPS

N. W. MOGGE T. G. YUNCKER

1914

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Ways and methods of hastening the growth of plants by small cold frames and protectors.

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Submitted by
N. W. Mogge and T. G. Yuncker,
To the Horticultural Department
Michigan Agricultural College,
June, 1914.

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Introduction:

In chosing this subject for investigation it was with the idea of determining to some little degree whether it would be a profitable enterprise to force certain vegetable crops under glass with the idea of bringing such crops upon the market at a time when they would bring the best price.

This is a decidedly practical question and one that should interest the man who lives in the city and who has only a limited space of ground to devote to the production of vegetables for his own table as well as the commercial grower who has the planting of several acres.

After diligent search it was found that very little work has been done as yet upon this subject, although the agricultural papers advertise forcers and protectors of all kinds, most of which have not received a trial in this section of Michigan.

Many crops such as lettuce, cucumbers, radishes tomatoes etc. are grown or forced in greenhouses, hot-beds and cold-frames. Other crops such as cabbage, cauliflower etc. are started under glass and thus obtain an earlier start.

There is need for investigation of this question as the writers could find but little in regard to the success of forcers and protectors such as are advertised in some of the agricultural papers.

Object:

The object of this work was to find ways and methods of has tening the growth of plants by the use of cold frames and protectors of various kinds, and to determine whether or not such forcing was a profitable venture for the vegetable grower.

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Apparatus:

The cold frames, 3 in number, were constructed for this problem by the writers. The sash for these frames were furnished by the Horticultural Department of the Michigan Agricultural College and was of the single glass style. The frames and sash were of the standard size, i.e. 6 x 3'. Pine boards 12' wide and 1" thick were used in the construction of the frames. We also used 1 8 "Ball Patented Plant Forcers" of the upright construction, their #3, Style A, price $2.62 per dozen, and 3 of "Ball Patented Melon Forcers", their #4, Style B, price $1.50 per dozen with glass and $.75 per dozen without glass. Two wooden box protectors size 18 x 12 x 12" from the Hort. Dept. were also used. These were so constructed with a groove that the glass could be pulled out permitting ample ventilation during the warm hours of the day.

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Table showing the data regarding the work done.

Crop	Variety	Time set out	No.	How Protected
Cucumber	White Spine	April 18th	9	7 Ball 2 wooden boxes.
" (")	"	April 21st	3	2 Ball 1 box
" (")	"	May 6th	4	2 Ball 2 box
Tomatoes	Livingstons Globe	April 28th	9	Style A Ball
" (")	"	May 6th	3	"
Melons	Long Is. Beauty	April 28th	6	Style B Ball
Asparagus	Conovers Colossal	April 28th	4	Cold frame
Rhubarb	?	"	2	"
Strawberry	Big Rock	"	6	"

Note:

(") These plants were reset in places where the frost had destroyed the plants placed previous date.

Asparagus. (Asparagus officinalis)

A small portion of the College asparagus field was selected in which soil was judged to be warmer and with the assistance of Mr. Davis of the Horticultural Dept. the cold-frame was located on what was believed to be a favorable spot. Our judgement was afterwards found to be fairly accurage as we secured in the 6 x 3' cold-frame 3 crowns or plants. The asparagus plants in the plot of ground were not the best owing to the fact that this bed of asparagus has been in use for over 20 years, and the plants are not getting rather spindly. The soil conditions in the asparagus bed, while not exactly idea, were very good. The soil consisted of a good loam which was exposed to the rays of the sun all day, and protected somewhat on the west and north.

The frame was thoroughly ventilated on the days when the temperature was not too cold so as to materially injure the plants . This was accomplished by raising and removing the sash during the warmer portion of the day and then rep laced when it became cooler in the afternoon. we found that there was a difference on the average between the inside and outside temperature of from 13° on a cloudy day to that of 25° on a warm sunshiny day. This, in fact, was true of all the frames which we had out.

There was no material advantage as regards the coming up of the plants, as those on the outside the frame and those on the inside came up all together the day following a warm shower which occurred about April 24th. On May 2nd the stalks were of a marketable size as regards length, being about 6-8" long. It will

The Cold-frame and Sash in Place in Asparagus bed.

be noticed from the above dates that it required 15 days to bring the crop to a marketable size. As the crop was not worth harvesting it was allowed to run to seed and the frame removed May 14th.

Conclusions:

We concluded that the forcing of asparagus by means of cold-frames is not a profitable commercial enterprise as little time can be gained in bringing the crop upon the market by these methods. The crop outside is ready at the same time and thus does not require the use and care of the crop in the frame. In growing asparagus under cold-frames there is a strong tendency for the crop to run to seed. It is possible, however, with the use of some warming agent, that the crop might have been matured earlier and better results obtained. On a younger bed, other things being equal, results would probably have been much more favorable.

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Strawberry (Fragaria Sp.)

The cold frame of the same type as thoat used for asparagus was located in the S.E. corner of the College strawberry patch, as shown in diagram which is on another page. The frame was placed so as to cover two rows of berry plants, there being about five in each row or a total of ten plants under the frame. The variety of berries which were under the cold frame was "Big Rock" which is a perfect variety.

The conditions in the patch are not especially good owing to the fact that the weeds were allowed to grow unchecked, but an effort was made to keep the weeds down inside the frame. No cultivation was given the plants other than the pulling of the weeds.

The method of culture used for the strawberry plot was the 'matted row', and the plants were good vigorous growers with plenty of runners.

The frame was thoroughly ventilated on days when the temperature was such that it would not injure the plants. This ventilation was accomplished by means of opening the frame in the morning and then replacing it again in the afternoon soon enough so that the frame would be warmed before the sun had disappeared for the day.

Up to the time of blossoming the plants inside of the frame appeared to be much more vigorous than those outside the frame, and blossoms appeared about 4 days earlier for the same variety than those on the outside, but as far as the ripening of the fruit was concerned it did not seem to ripen more than one or two days earlier than those on the outside. It was noticed that the

a b

Strawberry plants.

a. grown in cold-frame

b. grown outside.

berries in the frame were somewhat larger than those outside, and this may account for the tardiness of ripening, as the fruit was forming much larger.

The plants in the frame were very badly infected with the leaf spot, (Mycosphaerella Fragariae), while those outside were not infected nearly so bad, showing that the foliage is more tender or susceptible to this disease or the conditions in the frame were more favorable to its development.

Conclusions:

It is the opinion of the writers that the use of cold frames employed to force the strawberry crop prematurely is not a profitable venture for the market gardener. It might be employed by a small grower, but the cost of the frame is so great, when compared with the small gain, that it would not be profitable.

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Ventilating the Strawberry Cold-frame.

Rhubarb (Rheum rhaponticum)

Two crowns of this plant were selected in a representative section of the college bed and a cold frame, similiar to that used for the strawberries and asparagus was placed over them.

The soil in the bed was a warm sandy loam and the exposure was southernly. Before the frame was placed, the field had been thoroughly cultivated.

Ventilation of this frame was affected in the same manner as for the other frames.

On April 28th two representative plants outside the frame were selected and from these and the two inside the frame the marketable stalks were cut. From the two outside plants 3.5 lbs. were obtained, while from the two on the inside 8# were cut. This was sold to a Lansing Grocer at the rate of 6 cents per lb., the grocer retailing it at 10 cents.

To obtain a comparison of the acidity content of the plants outside and those inside the frame an analysis was made of several stalks from each source, and it was found that the plants inside were 42° (Fuller's scale) lower in acidity content than those outside.

There was a greater number of stalks per plant inside than outside and these were more spindly, the plants on the outside being short and thick. The plants on the inside were more agreable to the taste than those on the outside, due, in all probabili ty, to the lower degree of acidity.

Conclusions:

From the results obtained with rhubarb it would

appear to be possible to place the crop upon the market from four to eight days before the crop outside would be ready to harvest. After the first cutting, in this experiment, the plants on the outside came along so fast that they were competing with those on the inside, and, owing to the stockiness of the individual stalks, would probably give a greater yield per plant than those inside the frame.

From a study of the condition of the local market it appeared that, providing you can get the crop on the market a week earlier than the regular crop, you could obtain double the price commanded by the regular crop, and, in fact, in this case, provided we could have placed the rhybarb on the market four days previous to the time we did, it would have brought from ten to twelve cents per lb.

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Ventilating the Rhubarb frame

Cucumbers. (Cucumis sativus)

With this crop, Ball's Patented Plant Forcers were employed. A warm sandy loam soil was selected just to the north of the college rhubarb bed. This soil was plowed and cultivated previous to our experiment. The plants were of the 'White Spine' variety and were started from seed in the green-house by the Horticultural Dept. These plants were placed in a row three feet apart Over 7 plants we placed the Ball Forcers, while over two the box style was placed.

The plants were frozen out twice owing to the fact that the Ball Seed Forcers afforded inadequate protection to the plants. In two of the forcers and one of the boxes we placed manure around the plant, but as far as could be ascertained this did not materially affect the results.

Owing to the fact that this plant is fairly snesitive to high temperatures as well as to frost great care was exercised to give the plants proper ventilation, this being accomplished by removing the glass from the protectors in the morning and then a gain replacing it in the afternoon.

Conclusions:

We concluded that the Ball Seed and Plant forcers were not suitable protectors for a crop of this nature because they bulged at the top allowing air between glass and paper. These protectors are advertised to last any number of years, but in the judgement of the writers those used on thecucumbers will be useless for next years work. The paraffine paper is not suitable for exposure in all sorts of weather, and this style of protector is so light that the wind can readily tip them over or blow them away.

The wooden boxes furnished by the Hort. Dept. were much more suitable for this work and had the advantage in that they were easier to ventilate than the parafine boxes. The glass can be pulled out or the boxes can be tipped up very easily.

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Tomatoes (Lycopersicum esculentum)

This crop was treated in the same manner as the cucumbers, with the exception that there were not any placed under the box protectors, but all under the Ball forcers. This crop was also badly affected by the frost and several resettings had to be made. The plants for these settings were obtained from the Hort. Dept. hot beds where they had been started from seeds.

Plants were placed in the same kind of soil as the cucumbers and were ventilated in the same manner. Plants were set three feet apart. The same style of protectors were used as for the cucumbers, and the same fault was found with the protectors as with the other crop.

Conclusions:

The plants which were left in the hot beds and planted in the open were as large as the ones protected, thus showing that the protectors used were inefficient as forcers of this crop.

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Tomatoes

Tomato plant grown under forcer.

Tomato plant grown in field.

Plant Protectors or Forcers over the Cucumbers.

Muskmelons (Cucumis melo)

The plants for this crop were obtained from the Hort. Dept. hot beds, and were set in the same kind of soil as for the cucumbers and tomatoes and were placed about four feet apart. The Ball Style # 4 Melon forcers were employed, these being different from the ones used for the cucumbers and tomatoes in that the top is flat and the glass is nearly flat instead of being nearly verticle as in the other style.

This style of protector seemed to be more efficient as the plants made a very good growth, but unfortunately final results could not be obtained, owing to the fact that during cultivation of the rhyberb bed the team was driven through our experiment destroying the plants and forcers.

Conclusions:

Owing to the shortness of the growth period, this portion of the experiment ran it is difficult to come to any definite conclusions in regard to the value of this forcer, but it would appear that this style of forcer was much more efficient than the upright style.

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General Conclusions:

1-Asparagus cannot be profitably forced under glass.

2-As a commercial venture it is not wise to try to force strawberries in a cold-frame.

3-The size of the strawberries was materially increased by the use of the cold-frame.

4-Foliage under glass in cold-frames on strawberry plants was much more susceptible to the leaf spot than that outside.

5-Two to eight days can be gained in the time of marketing the rhubarb crop by the use of the cold-frames.

6-Quality of rhubarb was improved by the use of glass.

7-The acid content of the rhubarb in the frame was 42° less than that outside.

8-Forcing rhubarb by use of cold-frame judged to be a profitable undertaking.

9-Use of paper protectors such as Ball Seed & Plant Forcers is not recommended for such plants as tomatoes, cucumbers etc.

10-Wooden boxes fitted with a glass slide are much better.

11-The flat style used with the melons proved to be the best type of p aper protectors.

12-The temperature in the cold frames was from 20-40° higher than that outside.

13-Earliness is such an important factor in securing high prices that it is a profitable enterprise to start plants under glass, but in this experiment little was gained by the use of the protectors as too many plants were lost through fromst injury and the plants that were held in the green-house and hot beds and were later plant ed in the open are just as far advanced as those protected by the protectors.

Bibliography.

Asparagus General Culture:

Arkansas Bulletin of Exp. Station #86

Kansas " " #70

Missouri " " #43

Ohio " " #25

Farmers " #61

Strawberries General Culture:

Michigan Exp. Station Special Bulletin #59

Forcing in general:

Bailey's Forcing Book

Watts Market Gardening

Corbett's Garden Farming

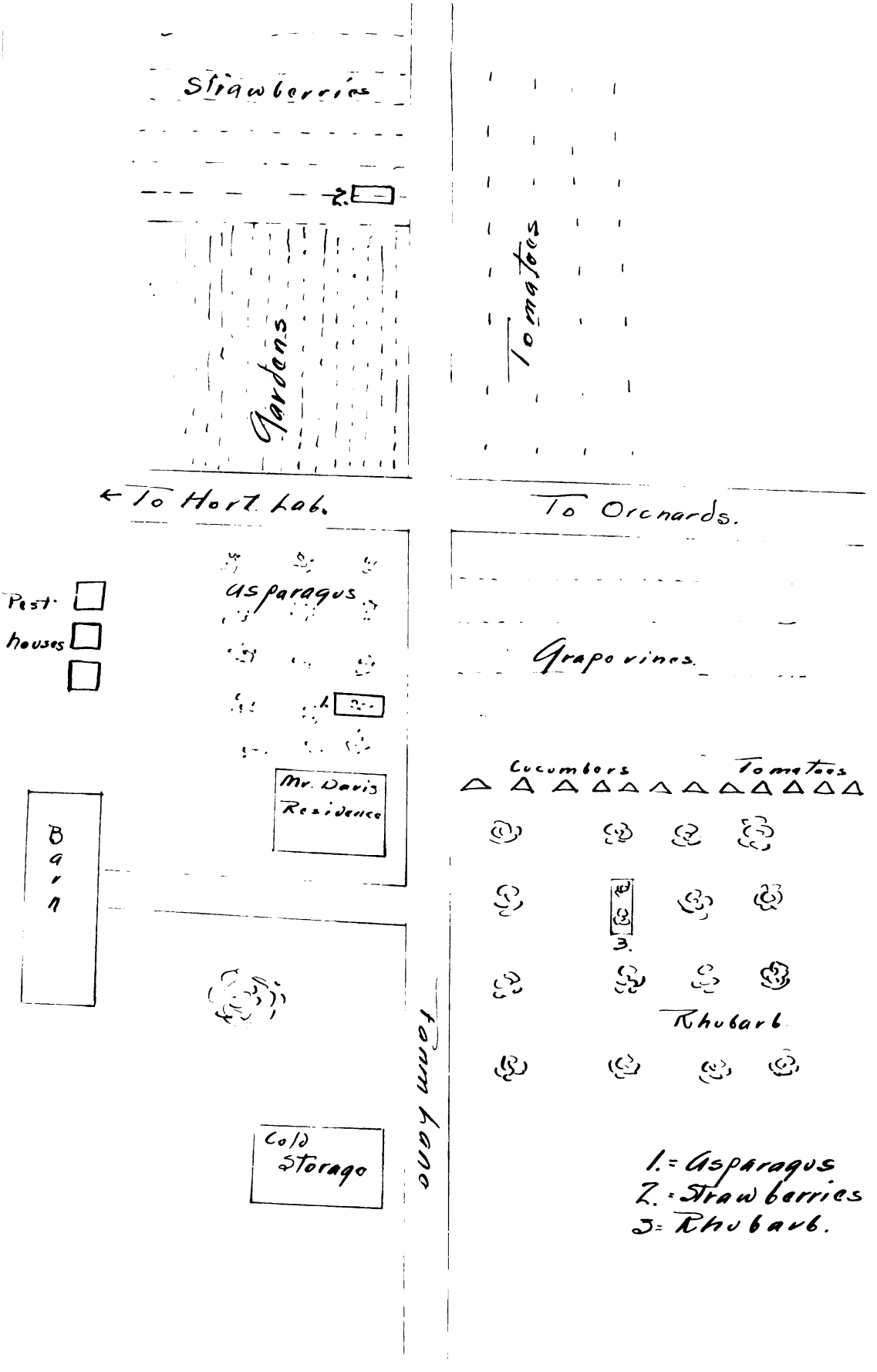
N. J. Report for 1906 Page #237

Vermont Bulletin #150

Several commercial catalogues

Report of the weather during the running of our Experiment copied from the U.S. Weather Bureau reports.

Date	Temperature Degrees F. Min.	Max.	Mean.	Precipitation in inches.	Char. of day.	% of possible sunshine
April 16	36	64	50	.02	Cloudy	57
17	41	71	56	.0	Clear	99
18	55	84	70	.0	"	63
19	38	65	52	.12	Cloudy	14
20	29	38	34	.07	"	0
21	30	66	48	.0	Pt."	72
22	40	61	50	.01	"	59
23	32	57	44	.0	Clear	92
24	43	61	52	.44	Cloudy	9
25	49	72	60	.66	"	39
26	60	61	60	.0	Pt."	59
27	47	78	32	.85	"	64
28	56	82	69	.10	"	77
29	41	62	52	.05	Cloudy	16
30	35	53	44	.0	Clear	81
May						
1	30	53	42	.0	Cloudy	39
2	33	62	48	.0	Clear	100
3	45	68	55	.0	Pt.Cloudy	53
4	51	74	62	.43	Cloudy	41
5	53	67	60	.0	Pt."	22
6	44	65	54	.0	Clear	79
7	40	65	52	.15	Cloudy	40
8	45	62	54	.02	"	30
9	39	70	54	.0	Clear	93


Strawberries
2.
Gardens
Tomatoes
← To Hort. Lab.
To Orchards.
Asparagus
1.
Pest. houses
Grapevines.
Cucumbers
Tomatoes
Mr. Davis Residence
Barn
3.
Rhubarb
Farm Road
Cold Storage
1. = Asparagus
2. = Strawberries
3. = Rhubarb.