THESIS

STUDIES IN THE CONTROL OF CUCUMBER DISEASES AND THE EFFECT OF SPRAYING IN BLOOM ON THE SETTING FRUIT

P. S. ARMSTRONG, H. J. BUELL, D. A. STROH.

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P.S.Armstrong H.J.Buell D.A.Stroh

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OUTLINE
Cucumber Disease Control
Part I

Spraying in Bloom
Part II

Spraying in Bloom in the Field
Part III

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- Outline. -

Part No. 1. Effect of Spraying on Cucumber Diseases.

GENERAL METHOD.

The work described herein was carried on under the general direction of the H. J. Heinz Company in an endeavor to determine a practical , efficient, and economical method of controlling the several diseases of cucumbers which had been a source of serious loss to the growers and to the Company in the past few years. With a view to determine the influence of regional conditions such as soil and climate, the experiments were conducted simultaneously in three states by P. S. Armstrong, at Princeton, Wisconsin; H.J. Buell at Big Rapids, Michigan; and D. A. Stroh at Plymouth, Indiana. The apparatus , methods, and materials employed were the same in all cases.

The apparatus was a fifty gallon barrel spray outfit manufactured by the Morril and Moreley Company, of Benton Harbor, Michigan. This consisted of a fifty gallon oak barrel mounted on 38 inch iron wheels. This was equipped with a No. 8 hand force pump with a capacity of 125 and 150 gallons per hour; seamless brass cylinder, brass valve cage and valves, steel air chamber , steel agitator, maleable handle, barrel plate, and head, brass discharge cross for 3/4 inch male hose threads. Designed for the side of the barrel. An additional feature of a pressure gage registering 500 lbs. An eight foot bamboo rod brass lined,with shut off attached to fifteen feet extra heavy hose, and fitted with a double Vermorel nozzle. Stock and dilution barrels with necessary materials for preparing Bordeaux mixture were provided.

With a very few exceptions all of the spraying was done with Bordeaux at a strength of 3-6-50 supplemented in a few cases with a nicotine spray for aphis applied either in combination with the Bordeaux or separate from it.

It might be well in this connection to consider briefly the system under which the cucumbers were produced and in a general way the cultural methods employed. The Heinz Company maintains a number of salting stations in each of the states mentioned located in a favorable pickle districts and along good lines of transportation, to which the pickles , grown under contract are delivered by the individual growers. This contract agrees to furnish sufficient seed for their contracted acreage. (2) The company agrees to purchase all pickles of a specified grade at contract prices delivered in crates at the salting station on the day of picking. (3) The grower agrees to plant and give proper attention as regards cultural methods to the contracted acreage. (4) The grower agrees to deliver all pickles of the acceptable grades to the Heinz Company. (5) The Company reserves the right of final sorting into the specified grades.

The Growers Service Department has recently been created to furnish the growers with free expert advice as regards the best cultural methods to be employed. The men assigned to this work have from one to several salting stations in their district comprising a total under their direction of 100 to 200 acres. They endeavor to visit at intervals of from one to two weeks every grower in their district, giving to each advice on cultural methods applicable, at that particular time. They give detailed instructions as

to preparation of the seed bed, planting, thinning, cultivation, insect control, training of vines, picking, sorting and any other necessary advice. These men used their influence as far as possible to influence the growers in favor of spraying.

We will now take up in detail the cultural methods used under this system in the different regions. The seeds which are furnished by the Company are planted directly in the field either in drilled rows or in hills. The time of planting varied from the 25th of May to the 1st of July, depending upon the locality and the growers preference, but in the majority of cases the planting was done between the 1st and 10th of June. The Company recommended a distance of seven feet between the rows although in many instances the growers planted at distances of from four to eight feet. The Company also advocated the drilled row system of planting and thinning the plants to a distance of two feet apart just before they began to run. This advice was also disregarded in most cases to the great detriment of the plants. Although clean cultivation is advised the methods employed by the growers vary in a great degree . Shallow cultivation is obviously the best as the roots come quite near the surface and extend in a network between the rows when the plants have reached maturity. Cultivation should be done following a rain to conserve moisture the aim being to keep a constant dust mulch and should be continued until the running of the vines makes it impracticable . Per haps the best tool to use is the spike tooth harrow or any other type giving shallow cultivation.

It was advised to train the vines in winrows as soon as they began to run sufficiently in order to facillitate picking, cultivation and spraying. Ordinarily this was followed, the vines being lifted and laid along the row. This will leave in the seven foot rows a space of approximately three feet between the rows to permit the passage of a spray barrel or a gang of pickers.

To obtain the maximum number of first grade pickings, it should be done early or daily when the growth is good although picking every other day will ordinarily suffice. The aim is also to prevent the development of large pickles, which bring much less in price and more than anything else seriously saps the strength of the vines. The maximum limit allowed for the first grade, which were purchased at the salting station during season of 1914 at one dollar per bushel, was three and one quarter inches in length. The next grade consisted of unmature pickles exceeding this length, and were contracted for at thirty-five cents per bushel. The lowest grade consisted of nubs and crooks, purchased at twenty-five cents per bushel. It was of course to the advantage of the grower to deliver all first grade pickles, and this could only be accomplished by frequent and careful picking.

The company urges the grower to sort carefully in the field and furnishes instructions for construction of a sorting table. This table is of simple design the table being hinged to its standards near the middle so that it can be easily tilted, the pickles running from the lower end into the basket. The table top is made of slats so that dirt and refuse will not collect. This sorting table is kept at the end of the field and the pickles sorted as they

are brought in. Under ideal conditions this system would be sufficient but in practice it is found necessary to check the sorting on a similar table at the salting station.

On the same day on which the pickles are received at the salting station the first and third grade pickles are vatted in a strong brine solution and are carried through the various stages of fermentation. The second grade of pickles or dills are washed immediately and put directly into barrels with brine, dillweed , and spices. Baume tests are run on the vats and the brine kept up to the requisite strength by the addition of salt as needed. In this condition the pickles may be held from six months to several years.

Cucumber Spraying Experiments at Princeton Wisconsin.

The town of Princeton is in one of the older settled regions of Wisconsin and at the present time is a thriving town of about 1600 inhabitants the majority of whom are of foreign birth or parentage. It is located upon the Fox River, which is a small stream , but with a ten foot channel connecting by navigatable waters the Great Lakes and the Mississippi River through the Wisconsin River. Princeton has good Railroad facilities being on an important branch line of the Chicago and Northwestern R.R., 36 miles Northwest of Fond du Lac. As before mentioned there is a large foreign element in the population fully two thirds being either Polish or German. Most of the farming consequently is done upon a very small , but extensive scale, hand labor and the simpler implements being chiefly used. The families are usually large and all of the children are commonly employed in picking the cucumbers on their farms, it being unusual for a grower to employ pickers. Almost without exception the growers seem to dislike the crop , but they continue to contract as it furnishes a reliable source of ready money as a cash crop and also as it gives very good returns for the amount of land used, which is an important factor on a small farm. Contracts were drawn for as little as 1/4 acre and as much as two acres ,the former type being in or near town and latter being on the larger farms from one to eight miles from the salting station. Experience proved that for the particular conditions existing this season that the larger acreages were the more successful .

The general character of the land is very sandy although there is some heavier land of the clay loam type on the upland and some land of the muck type on the lower levels. practically

all of the land devoted to the growing of cucumbers, however, was sandy , some being almost a pure blow sand which seemed incapable of supporting plant life in time of drought. Very often it happens especially in the smaller patches that no rotation of crops is practiced. The common plan of planting in this region is the winrow the rows being seven feet apart as advised by the Company , but often much less than that. It occasionally happened that interplanted crops were used such as beans or corn in the small garden patches in town, to the great detriment of the cucumbers in times of dry weather. At the next salting station at Ripon many plantings were made under the hill system, but this was not true of the patches around Princeton.

The general crops grown in the vicinity were beans, corn, and potatoes, the first named being the staple. Most of the farming and dairy industry is done on a small scale and under rather crude old fashioned methods according to comparison with modern implements. The country in general is very rolling. Because of the foreign character of the population and on account of the fact that no fruit is grown in the region spraying is practically unknown, and so t he introduction of theexperiment excited much comment and some distrust and suspicion . Very few of the growers realized the presence of a disease and attributed most of the failures to the weather so it was very difficult to obtain any authentic information as to the history or appearance of any disease in the region . Two troubles were recognized by some, first, the blight which was the general term applied to all leaf spot troubles, and second the rather new trouble which we term the white pickle, but which had no common term among the

growers.

With these conditions in mind it will be recognized that the attitude of the growers toward the experiment was not helpful or encouraging, but rather for the most part critical and suspicious and in some cases curious , but rather skeptical.

In a few cases, however, there was some attempt at real cooperation by the grower in furthering the interests of the experiment. This was a critical year for the pickle business in that vicinity for the crops had been a decided failure for the past two years and farmers were living in the memory of the days of plenty four years before when profits of from $150.00 to $200.00 per acre were not uncommon. That was the first year of pickle growing around princeton and the yields reported that year have not been approached since. Whether this much reduced yield is due to coincident weather conditions or whether it is on account of the increased amount of disease remains to be seen, but what ever the cause a satisfactory explanation of it would have an important influence upon the location of stations.

This general survey of the conditions around Princeton will serve to acquaint the reader with the conditions under which the work was done both as to the cultural methods employed, and the attitude and cooperation of the growers in experimental work of this nature. With this general outlook I will now proceed to a detailed description of the different patches which came under the experiment, the conditions of soil and culture, the prevalence of diseases, and the amount and methods of treatment in each case. In addition there will be given brief accounts of various diseases present, their symptoms and spread, and also weather report and

other items of interest to the experiment.

Methods Employed .

In most bulletins concerning the control of the fungus diseases of cucumbers it is stated as almost essential or at least very desirable that both the upper and under sides of the leaves be coated with the spray solution in order to afford full protection to the vine. With the type of spray apparatus used this method was rather impracticable because the highest efficiency of the misty spray from the vermorel nozzle is reached at a distance of eighteen inches from the nozzle ,and if this distance of application be made less the solution puddles on the leaf, and much runs off which is neither economical or efficient. In addition the experiment was carried on to determine the advisability of recommending spraying as a practice to the grower and it is certain that the majority of growers would never take the pains to run the nozzle on the under side of each runner. There is also another point to be considered in this relation and that is the spray injury to the blossoms. Although no very definite figures are at hand to prove this statement indications point to the fact that Bordeaux has a very injurious effect on the fertilization of the flower. Experiments are to be conducted in the greenhouse to determine the effect of the fungicide on the pollen and on fertilization. If this injurious effect is true in any appreciable measure as it would seem, then the practice of spraying under the vines would subject many more flowers to the effect of the fungicide and reduce the yield accordingly. This is a factor worth consideration and if the diseases can be controlled approximately as well by only

spraying the upper surface then for many reasons this would be the best practice.

Owing to the scattered location of the patches treated it was necessary to establish several filling stations. The equipment at each of the five places consisted of four barrels, two for stock solution and two for dilution barrels, and sacks in which to suspend the copper sulphate. This was always located as near as possible to a convenient water supply. Enough of the stock solution was made up at a time to make about 200 gallons of spray solution, the lime being freshly slacked as needed. In order that the stock solution would not become more concentrated by evaporation the depth of the solution in the barrel after each filling was measured and water added at the next time to equal this measurement. The Bordeaux was made freshly each time and poured into the barrel alternately lime and copper sulphate from the dilution barrels, being tested each time with potassium ferro-cyanide to insure the absence of free copper.

Patch Records.

PATCH No. 1. Mr. E. Hennig.

Soil: Very sandy, used for cucumbers the previous year.

Cultivation: Not cleanly cultivated.

Acreage: .4 acre, amount sprayed .3 acre.

Remarks: Not much insect injury had occured and the vines were vigorous though quite small. Grower was willing that the experiment be carried on, but in a passive way.

Treatment: Sprayed July 20th, 40 gallons. No diseases apparent. Sprayed July 28th, 25 gallons. Some leaves in both the sprayed and unsprayed parts are yellowing somewhat but the damage is not much as yet although the plants remain very small. No insect . Sprayed August 4th, vines remain very small with misshapen fruit showing plainly the effect of drought and lack of cultivation. A number of vines in both portions are yellowing, but not many have completely wilted. Aphis on a few of the vines, there are a few spots of anthracnose on the unsprayed side. August 20th, tip burn and a general lack of vigor in the vines whichare very small and not yielding. Regular spraying discontinued because the vines are valueless for experimental purposes.

PATCH No. 2 Mr. Michealowski.

Soil: Very sandy, same crop the last season.

Acreage: .5 acre in two patches. Sprayed .1 acre in the accessible patch.

Cultivation: Clean but the rows are only four feet apart, and vines are too close in the row. In the larger patch there is an interplanting of corn.

Remarks: Not much insect injury had occurred to the vines, but owing to the drought and the light soil and close rows

the vines are in very poor condition,wilting in the sun. Treatment: July 20th, sprayed portion of the smaller patch, 35 gallons. No diseases or insects present but the vines are wilting badly in the heat of the day from lack of moisture. July 28th, visited but did not spray on account of the extreme weakness of the vines. Yellowing and effect of dought was very pronounced. A number of the vines are dead about equally in the sprayed and unsprayed part. Aphis are becoming abundant. August 20th, tip burn and general lack of vigor. Picking discontinued and only the one spraying was given. White Pickle appeared later in the season.

PATCH No. 3. Mr. Geise.
Soil : Sandy, used for same crop the previous year.
Acreage: .5 acre, amount sprayed .25 acre.
Cultivation: Clean and the rows are seven feet apart.
Remarks: Entire patch had to be replanted because of injury by the cut worm and striped beetle. The vines are vigorous and of a healthy appearance and good growth.
Treatment: July 20th, sprayed 45 gallons. No diseases apparent but some insect injury to leaves. Vines appear in good condition July 28th, sprayed 35 gallons. Remarkable change in appearance of the patch. Many vines dying and a few dead showing a yellowing of the old leaves with a dry brown at the top. Very few of the leaves are spotted, but the aphis are very abundant on the yellowing leaves. Vines are dying on both sides of the patch. August 4th, sprayed a few gallons. Parts of whole rows are dead , the trouble progressing consecutively from vine to vine . Aphis are very bad and are undoubtedly the cause of the shriveling and the death of the vines. Spraying does not check either the aphis

or the tip burn. Anthracnose is spreading in the unsprayed portion and although a few spots appear on the sprayed side it is marked worse on the unsprayed. August 6th, visited but did not spray as the leaves are still well coated and about half of the patch is now dead and in two of the sprayed rows particularly the dead portion is solid. The aphis actually seem to prefer the sprayed leaves. Grower reports the same condition was present in the same place last year. The tip burn is fully as bad in the sprayed area. The white pickle is also present but seems to me more serious as a leaf infection in this case for although fully 85% of the leaves have the characteristic yellowing, the fruit symptoms are relatively small. August 13th, vines are practically all dead and have ceased to bear , and picking has been discontinued. August 20th. Disease survey shows white pickle, tip burn, aphis , and anthracnose.

PATCH No. 4. Mr. Siepert.

Soil: Varying from a very light sand to a sand somewhat heavier.

Acreage: 1 acre, sprayed .2 acre on the average type of soil.

Cultivation: Clean , but the rows were about five feet apart and the vines much too thick in the row. Readily affected by drought on the light sand.

Remarks: Vines are quite vigorous but the rows are much too close , running together in some cases.

Treatment: July 22nd, sprayed 25 gallons. No leaf diseases are present, but occasionally a vine shows symptoms of bacterial wilt. July 28th, sprayed 25 gallons. A yellowing of the leaves is apparent in a limited degree. A few vines are dead on both sides probably from the wilt. The patch is

beginning to show the effect of drought especially on the lighter soil. August 4th, sprayed a few gallons. The vines have made so little growth that spraying seems useless as the leaves are still well covered. Was afraid to spray much on account of the detrimental effect of the heat. A number of the vines are dead probably from drought. Anthracnose is just starting and is noticeably more serious on the unsprayed side although present in some cases on the sprayed leaves.

August 15th, did not spray because the vines were so badly wilted, many dead or nearly so and have made no appreciable growth. Diseases have not spread much, death is due to lack of rain.

August 20th, survey, showed tip burn.

PATCH No. 5 Mr. F. Oelke.

Soil: Clay loam and sandy loam. Rotation practiced.

Acreage: 1.5 acre, sprayed .5 acre.

Cultivation: Quite clean for large parch. Rows seven feet apart.

Remarks: This was the first of the farm patches sprayed and was very well adapted to experimentation , the rows being far apart and the vines thinned. The striped beetle had given some trouble and had thinned the vines so the rows were not full and regular. The vines were planted later than usual and were small although vigorous.

Treatment: July 22nd, sprayed 45 gallons, no disease present, but there is some insect injury to the leaves from the stripped beetle. Sprayed also 5 gallons on a small home patch on new ground , but near some vines showing white pickle and anthracnose

July 28th, no injury from spray, vines much the same.

July 30th, Vines much the same , no disease apparent.
August 1st, 100 gallons. Vines still small, but healthy except for a few aphis and an occasional leaf spot.
August 11th, Sprayed 100 gallons. A number of the vines are suffering from the aphis especially in the sprayed area. There is also a slight attack of both the anthracnose and the white pickle , but neither of these is spreading rapidly as yet. The pickle pickers report a slight decrease in yield on the sprayed side.
August 17th, sprayed 100 gallons. Diseases are not prevalent yet although the white pickle is noticeable in places. Aphis are the chief cause of concern , and they are spreading rapidly especially in the sprayed area. The small garden patch is almost wholly affected with the white pickle. Spraying on the small patch discontinued.
August 20th, the aphis have spread with a remarkable reapidity killing many of the vines in large areas chiefly on the sprayed side. An attempt was made to check then before they had such a start by spraying with nicotine solution from a small had potato sprayer , but this proved entirely inadequate to check. A large number of the vines remaining are not affected by the white pickle.
August 24th, patch practically destroyed, spraying and picking discontinued. Aphis have rapidly destroyed the patch assisted by the white pickle. The aphis seemed to kill the vines almost over night when the time of rapid spread was on,all leaves being completely destroyed.

PATCH No. 6. Mr. Behm. (three patches)
Soil: Patch (a) Light blow sand to considerable depth.
Patch (b) Medium sand.

Patch (c) Light springy muck.

Acreage: 1 acre about equally divided between the three. Sprayed .1 acre of patch on light sand, and started on the patch on the medium sand.

Cultivation: Good in all cases, except that rows were only three or four feet apart, and the vines were too thick. This crowded condition proved very detrimental in the dry period. The patch upon the light sand drying up completely, and that on the medium sand suffering to some extent. The patch on the muck survived the drought much better than the other two, and the vines were more vigorous.

Remarks: This patch was one of the most interesting experimented upon because of the different types of soil, and the fact that a severe wilting occurred after the first spraying, after which the grower refused to have his other patches treated.

Treatment: July 21st, sprayed half of the patch upon light sand, and a small portion of the patch on the medium sand early in the morning of a very hot day. The vines in the first patch had begun to wilt before the spraying was completed from the heat of the sun. The patch had been badly wilted during the heat of the day for several days previous but had recovered under the stimulus of the dew and cooler weather at night. On the next day after the spraying however , the sprayed plants did not revive as did the plants in the check rows. There seemed to be no burning effect , merely a wilting of the vines and in some cases a drying in the heat of the day following. A fact to corroborate the belief that the wilting was due to the intense heat coupled with the application of water in the sun was apparent in that two vines which were protected from the sun by the shade of a straw stack were as normal as the unsprayed .

Another fact which bears out this statement is that the patch on the medium sand where more moisture was available so that the wilt was not as pronounced showed no ill effects or difference from the unsprayed on the few plants which were treated. These were sprayed from the same solution and on the same marning. The conclusive fact drawn is, that vines cannot stand the physical effect of a cold spray when in a wilted and much weakened condition.

Anthracnose is showing on a few leaves in patch (b) and (c) being confined to a few vines.

July 28th, visited; some of the vines in the side injured by the spraying have recovered and these and many others on the unsprayed side show very yellow leaves with brown tips. Many of the vines are dead and all are small and weak in the light sandy patch. The other patches look well although some bacterial wilt is evident, and the spray seemed to check the anthracnose somewhat in the small portion sprayed where the disease was already present.

July 30th, vines still dying badly; anthracnose spreading to the lower patch on the muck soil.

August 8th, vines in the light sandy patch through bearing. In the patch on the medium sand the anthracnose has spread steadily from the corner in which it started July 21st, nearly 50% showing some infection and 4 or 5% having died from this cause. A drying of the leaves is plainly noticeable at a distance and vines show lesions on the stems almost girdling in some cases.

August 20th, Survey. Tip burn and white pickle are prevalent in the upper patch (a), which has stopped bearing entirely. In the middle patch (b) anthracnose is prevalent and some

angular spot. The lower spot (c) shows considerable yellowing of the leaves and some leaf spot.

August 28th, White pickle has come on rapidly since the rain and the two lower patches are badly infected one being almost finished from this cause. Anthracnose has spread rapidly since the rain and practically every leaf in the two patches is yellowing. A large amount of this infection has developed since August 20th. A number of specimens were collected from this patch and the progress of the various deseases was watched carefully.

PATCH No. 7. Mr. Klawitter.

Soil: Sandy loam, fairly heavy. Planted to cucumbers last year.

Acreage: .5 acre, sprayed .2 acre.

Cultivation : Clean , rows seven feet apart, and vines are still too close in the rows.

Remarks: This is a small garden patch and has been under intense cultivation for years. A few trees in one end has kept the growth small in that part. Vines are vigorous and well attended.

Treatment: July 23rd, sprayed 25 gallons. No diseases are apparent, and the vines are vigorous and in good health.

July 28th, visited, patch much the same. Few cases of wilting and dying and a few vines are yellow. One suspected of white pickle found.

July 30th, sprayed 35 gallons. A number of vines are suffering badly from aphis which causes a yellowing. These vines were removed from the patch and burned. A small amount of bacterial wilt is also present, but in isolated cases. Vines quite vigorous.

August 7th, Sprayed 5 gallons. Vines were so badly wilted from the heat and the coat from the previous spraying so well preserved that I considered it useless as well as dangerous to spray under the conditions. The white pickle symptoms have appeared in a few more places rather isolated from the first and have spread from these spots as centers.
August 10th, fully 25% of the patch is affected with the white pickle. The plants first affedted have ceased to bear . A number of vines are wilted from some other cause. Aphis seemed to have been checked by removing and burning the vines , but still are present in some numbers.
August 18th, fully 90% of the vines are affected with white pickle, and practically all of the fruits are diseased so that the patch is finished and picking has been discontinued. Ceased to spray for these reasons.
August 20th, vines have all been pulled up by owner.

PATCH No. 8. Mr. Kalupa.
Soil : Clay loam, planted last year and had a very serious outbreak late in the season.
Cultivation: Clean and rows are only about five feet apart. The vines are not thinned sufficiently in the row.
Acreage: .8 acre, sprayed .3 acre.
Remarks: This patch is about the most vigorous one in the experiment. Although the vines are very thick in the row the plants are very healthy and show a strong growth probably due to the thorough cultivation, the rich soil, and better moisture conditions in the heavier soil.
Treatment: July 23rd, sprayed 50 gallons. White pickle has been reported by the pickers in isolated cases. Insect injury slight. Vines very vigorous and making a strong growth.

July 28th, visited, vines in good condition and very thick. Several vines are dead from the bacterial wilt. Several vines show a yellowing of the leaves. One suspected white pickle found.

July 31st, sprayed 65 gallons, vines on the whole are very vigorous , thick and green, but with a few cases of yellowing. Rows are closing together because of the strong growth? No diseases are apparent and only slight insect injury. Have marked the vine where the white pickle was found to watch developments.

August 1st: Visited, several cases of white pickle noted by the yellowing of the leaves and the fruit showing green warts on an abnormally white and smooth surface.

August 7th: Sprayed 55 gallons. Vines had made very little growth and were well covered from the last spraying. White pickle becoming quite general about 15% of vines being affected. Vines although standing up much better than most patch under the long continued dry heat are beginning to dry somewhat.

August 10th: white pickle is spreading generally in both the sprayed and unsprayed parts, but so far is worse in the unsprayed part around the center where it first started. It presents two types of injury , one a mottled yellowing of the leaves with the fruit hard and whitened and with green warts, and second a dwarfing of the foliage, the leaves being very dark green with whitened veins. If fruit grows on this type of vine it does not whiten as on the other but is mottled with dark green warts. The leaves become rather crinkly. I believe the second type to be a later stage of the disease. After eighteen days from the first signs of this disease the pickers report and observations indicate that fully 35% of the

pickles are white and diseased.

PATCH No. 9. MR. A. Oelke.

Soil: Sandy loam, and clay loam in the lowland and rather heavy. Not planted to cucumbers before.

Acreage: 3. acres. Sprayed .75 acre.

Cultivation: Well cultivated, with rows full seven feet apart . Vines are small especially in the parts overlaid with sand.

Remarks: This is the largest patch in the experiment and is well adapted to the work as the rows are far apart and will permit of the driving of a horse in the rows. Grower is much interested in the outcome of the experiment.

Treatment: July 25 - 27th, sprayed 100 gallons. Vines are not very large, but no diseasesare apparent and insect injury only light.

July 28th, visited, Vines in good condition but small. No diseases or insects save the cucumber beetle.

August 3rd, sprayed 150 gallons. Vines in good condition, but small. No diseases or insects except that a very few leaves are spotted in the unsprayed part and a few runners affected with the bacterial will.

August 4th, visited. Vines are making a fairly good growth, but are showing the effects of the drought, and nearly all of the leaves are covered from the previcus spraying. A few vines on the unsprayed side have anthracnose slightly, a few aphis are also present on the sandy area. The spray has caused no visible injury to the vines , but the pickers report that the yield which was formeraly higher in now lower on the sprayed area, and that the fruit are mostly nubs. Claimed that the spray had injured the blossoms. Grower

will not allow to spray again until a rain comes for these reasons.

August 11th, Vines growing well under the conditions. A few vines of white pickle, a few of anthracnose, and a number affected with aphis. These three troubles seem to be confined principally to the higher ground which is sandy, although the aphis are quite generally distributed. The anthracnose does not seem to be spreading much.

August 14th, sprayed 100 gallons. The white pickle is now more noticeable , and now about 20 - 25% of the vines are affected . The anthracnose has not spread much but the aphis are very serious. Gave 25 gallons of nicotine water to the owner who is spraying with a small potato sprayer, but the infection is so general that do not expect to check. Sprayed rows are not very vigorous and have not made much growth since the last spraying.

August 20th, disease survey. White pickle, anthracnose, and serious infestation of aphis which are killing many vines.

August 22nd, sprayed 65 gallons. Aphis have killed fully a 15% of the patch and have damaged much more and are still spreading rapidly. White pickle has claimed about 2% and the anthracnose is bearly noticeable. The white pickle and lice together up to this time have damaged the yield about 50% . The patch is washed badly from the rain in several places. In spite of the rain the lice are beginning to work badly again, and the infestation is very general. Both the white pickle and the lice are at present worse on the unsprayed side, but there is not much choice.

August 31st, the patch has been entirely destroyed due principally to the aphis , but also to the white pickle to

considerable degree. These two troubles have ruined the patch for experimental purpose as far as fungus troubles are concerned because the Bordeaux seems to have no inhibiting effect whatever upon the lice or the white pickle, in fact lice seem to prefer weakened leaves or leaves coated with Bordeaux. One attempt was made to check the lice in the later stages by the application of 40 gallons of nicotine water to the sprayed side in order to save them and test their immunity to fungi, but althought many lice were killed the spread was so rapid from the unsprayed side the work was unavailing.

PATCH No. 10 Mr. Kalupa.

Soil: Heavy dark loam on lowland. Not planted before to cucumbers.

Acreage: 1. acre, sprayed .3 acre.

Cultivated: clean culture , but the rows are only about four feet apart, and the vines are thick in the row.

Remarks: This is a very vigorous and although the ground is very thickly planted and intensely cultivated the plants are extremely vigorous with dense foliage.

Treatment: July 25th, sprayed 50 gallons. No disease apparent and the insect injury from the beetle but slight. Foliage very dense and close. Rows almost grown together.

August 1st, sprayed 50 gallons. Vines very vigorous . Some leaf spots appearing on isolated leaves , but no serious injury.

August 7th, Vines still vigorous but yellowing in places. Anthracnose is not spreading noticeably.

August 11th, sprayed 50 gallons. Vines on the high end of patch have not grown much but on the lower part are doing well.

Anthracnose is not spreading much. White pickle becoming apparent in several places as indicated by the leaves. A number of the leaves do not look vigouous in the center of the vines. Not very many aphis.

August 20th, whitepickle, slight tip burn, vines growing well. Diseased areas caused by the anthracnose have been washed out by the rain leaving a shot hole effect.

August 24th, sprayed 40 gallons. White pickle claims about 15% of the vines. Few aphis present. Anthracnose not noticeable. Vines quite vigorous in the lower half but are not setting many blossoms. Weather not favorable to growth.

September 1st, sprayed 35 gallons of Bordeaux and also previously 25 gallons of nicotine water to check the aphis. Nicotine seemed to kill a large percentage of the lice. The unsprayed rows are showing an attack of the anthracnose and the angular spot. White pickle has spread slightly.

September 7 th, sprayed 25 gallons. Sprayed rows are now noticeably more healthy than the unsprayed and are yielding more. The white pickle is increasing, and also the anthracnose and angular leaf spot, but the nicotine seems to successfully checked the lice. The yields are quite small now, however, and the patch is about finished. This patch has been peculiarly resistant to all kinds of troubles even resisting white pickle for a long time. The lice never became serious, nor did the fungous troubles. Although the patch ceased to bear before it should, it outlived all of its enemies while other patches in the near vicinity were completely destroyed.

PATCH No. 11. Mr. Leuk.

Soil: Medium sandy soil. Planted to cucumbers previous year.

Acreage: .3 acre, sprayed .15 acre.

Cultivation: Clean, rows close , 4 feet, and vines thick,

Remarks: This was a small garden patch in town and easily accessible.

Treatment: July 29th, sprayed 3 gallons, Some of the characteristic yellowing is present and a few of the vines are dead showing also the effect of the drought. Insect injury slight.

August 4th, sprayed 55 gallons, anthracnose has started in both parts slightly worse on the unsprayed. Suffering badly from drought and man y of the vines are yellowed.

August 7th, about 5% of the sprayed vines have some anthracnose and 15% of the unsprayed. Hill first affected on both sides are now practically dead.

August 15th, requested not to spray anymore because the sprayed rows were yielding so many less than the unsprayed ones. Vines look about the same in both parts, but the anthracnose is much more general in the unsprayed part although on account of the dry weather it is not spreading enough to materially injure many vines. White pickle is noted in many places.

September 2nd, practically entire patch is dead partly from the white pickle but chiefly by the anthracnose The sprayed rows survived the best but neither woudl afford a picking as most of the fruits are affected with white pickle.

PATCH No. 12. Mr. Sohry.

Soil : Medium sand, the first year in cucumber.

Acreage: .5 acre, sprayed .2 acre.

Cultivation: Clean, but the vines are much too thick in the row, and the rows only four feet apart.

Remarks: Vines show some insect injury as well as a general yellowing.

Treatment: July 20th, sprayed 20 gallons. Vines show the effect of drought, and are yellowing with the typical signs. In good cultivation. A few leaves are spotted as if with anthracnose in both parts.

August 5th, sprayed 25 gallons, vines are very badly wilted from the heat and many leaves are yellow. Anthracnose is present in both parts. August 6th, Same as above.

August 15th, too badly wilted to spray and most of the leaves are already covered. Disease is not spreading much but the vines are drying up from the heat.

August 18th, sprayed 15 gallons. Vines have revived considerablly since the rain. Disease is not spreading much but the vines are drying up from the heat.

August 20th, Disease survey, tip burn and the leaf spot. Later not serious now. Few cases of white pickle.

August 24th, white pickle about the same. Angular leaf spot is showing up after the rain.

August 28th, sprayed 15 gallons, white pickle the same. Anthracnose the same. Angular leaf spot shows a bad infection on about every vine on the unsprayed side giving a yellowedappearance along the center of the row. This condition is noticeably different on the sprayed side, very few leaves being affected. Yield also reported much better on the sprayed side.

September 3rd, sprayed 20 gallons. White pickle the same. Angular spot increasing and the difference between the sides

is even more noticeable. A few lice were noted on some of the vines, but too late in the season to do much harm. A few gallons of nicotine were applied at the end of the Bordeaux treatment to kill these.

PATCH No. 13. Mr. Krafjack.

Soil : Medium sand. Not planted before.

Acreage: .6 acre , sprayed .3 acre.

Cultivation: Good and the vines are vigorous, showing no injury at all.

Remarks: patch easily accessible and the vines seem well adapted for the experiment. Rows full seven feet apart.

Treatment: July 29th, sprayed 40 gallons. Vines in very good condition. No injury apparent.

August 5th, sprayed 35 gallons. Vines in a pretty good condition considering the heat. Anthracnose shows in a very few places on the unsprayed side.

August 6th, vines remain much more healthy than those in the vicinity. There is very little anthracnose and the disease is not spreading.

August 15th, too little growth and too weak to spray. Disease not spreading. A few white pickle symptoms are present. Yield reported slightly better on the sprayed side.

August 18th, sprayed 30 gallons. Vines plainly show the effect of drought. The plants are in fairly good condition and the diseases have not spread.

August 20th, disease survey. Tip turn, white pickle slight, the shot hole appearance caused by the beating out of the diseased areas of leaf spot by the rain.

August 24th, white pickle slight, Angular spot coming again.

August 28th, white pickle present. Sprayed 25 gallons. White pickle about 10% worse on the sprayed side. Angular spot is quite prevalent on the unsprayed side, but on only a few leaves on the sprayed side. Difference is readily apparent from a distance.

September 3rd, sprayed 30 gallons. White pickle has now increased so that about 20% of the patch is affected. The angular spot and the anthracnose have increased over the unsprayed side, so that the difference become more apparent. Lice have been observed in a few cases on the leaves.

September 8th, sprayed 25 gallons, and also nicotine water for lice. Vines after being sprayed were left rolled over for the day .

PATCH No. 14. Mr. Soberalske.

Soil: Medium sand. Not planted before although cucumbers were planted in an adjoining plot the previous year.

Acreage: 1 acre, sprayed .5 acre.

Cultivated: Well cultivated. Rows about six feet apart and plants rather too close in the row.

Remarks: Vines quite vigorous. Trouble with cut worms earlier in the season. Some beetle injury. A few aphis.

Treatment: July 30th, sprayed 75 gallons. Some yellowing present probably the effect of the drought which has been generally serious on the sandy land, but the vines are quite vigorous.

August 5th, sprayed 50 gallons, vines are wilting quite badly from the heat and have made scarcely any growth. Anthracnose present and is worse on the unsprayed side. A few vines are drying from other causes.

August 7th, A marked difference in the early stages of

infection of the anthracnose in the sprayed and unsprayed sides, the former showing relatively few spotted leaves. All vines are wilted badly by the heat. Yield reported the same on both sides.

August 15th, too little new growth and too wilted to spray. Disease is apparently not spreading much.

August 18th, sprayed 45 gallons. Vines have made scarcely any growth , but are revived from the rain. Leaves are still well covered with spray and the diseases have not spread.

August 20th, disease survey. Old anthracnose infection shown by the shot hole appearance of the leaves. Slight yellowing and tip burn. Plants are now setting many blossoms.

August 28th, sprayed 50 gallons. The angular spot seems to have come on since the rain and there is a very noticeable difference between the sprayed and unsprayed sides, the unsprayed showing about 75% infection and a very slight amount on the sprayed side. Anthracnose seems to be also present but not to the degree of the angular spot. White pickle has now shown up in this patch and is evident in the picking. About 10% of yield affected.

September 3rd, sprayed 60 gallons. Anthracnose and angular spot increasing. White pickle abou t the same. Anthracnose noted in a few places on the sprayed side and is very apparent on the unsprayed vines.

September 9th, sprayed 50 gallons. Used some Bordeaux containing nicotine for the lice and funfus in the same spraying. Lice are quite general, but not serious. Very noticeable difference between the sprayed and unsprayed sides as to the angular spot and anthracnose. White pickle has increased slightly and the vines are about through bearing in

any quantity.

PATCH No. 15. Mr. Witt.

Soil: A medium light sand. Planted to cucumbers previous year.

Adreage: 1 acre, sprayed very small portion once.

Cultivation: Good. Rows six feet apart.

Remarks: This patch is not one in the regular treatment , but presents some very interesting facts concerning the experiment An agreement was made with the grower to spray 5 gallons, the grower appeared and refused to let any further work be done. The patch was therefore abandoned from July 29th, until the 1st of September. At this latter date I again visited the patch and found that the vines had suffered severely with an attack of anthracnose and that all of the vines with the exception of the few in the small sprayed area were entirely destroyed. The vines in the sprayed area were still green and quite healthy for the season of year and were still in blossoms In this case the one application of Bordeaux afforded a very remarkable protection, and this protection was very readily apparent. The vines were still somewhat white from the spray although the Bordeaux had been applied five weeks previously. This was the most striking instance of protection in the whole experiment.

PATCH No. 16. Mr. Redman.

Soil: Quite sandy, not planted to cucumbers before.

Acreage: .5 acre, sprayed .2 acre.

Cultivation: Good. Rows only four feet apart and plants too close in the row. Vines vigorous at upper end, but very small at the lower end near the row of shade trees.

Remarks: This patch was sprayed upon the request of the grower who had heard of the treatment to other patches.

Treatment: July 31st, sprayed 45 gallons. Vines quite vigorous. Insects not serious except a few aphis. Anthracnose apparently starting in places on both portions. Some effect of drought and some yellowed leaves.

Have not sprayed since the first application because on account of the dry weather vines would not need it or stand it Diseases have not spread to any noticeable extent but many of the vines are yellowing badly. White pickle has started in this patch.

August 21st, there are a number of dead vines due to the aphis and vines had practically ceased bearing during the dry spell. White pickle is now quite prevalent, and since so few healthy vines remain have ceased spraying.

August 31st, Entire patch is practically dead from aphis, white pickle, and tip burn. Some anthracnose and angular spot present but not as an important factor in the destruction of the patch. This is but another instance of the case where the fungicide was applied, but was useless as far as the experiment was concerned for the patch was destroyed by other agencies.

PATCH No. 17? Mr. Dalka.

Soil: Heavy sand, some loam. Not planted before nor has any patch been nearer than a quarter mile.

Acreage: 1.5 acres. Sprayed entire patch for lice and .7 acre with bordeaux for the fungus.

Cultivation: Good . Rows seven feet apart but are slightly too thick in the row.

Remarks: This patch was taken on late in the season principally for the purpose of experimentation in the control of aphis, with the commercial nicotine solutions, both in water

as a medium and also Bordeaux. The results obtained were probably the most thorough and conclusive in the whole experiment as the patch remained alive until the end of the season, long enough so that definite conclusions could be drawn without so many disturbing factors.

Treatment: August 7th, visited and made arrangements to spray. Shows a small amount of anthracnose , a little white pickle and a number of aphis.

August 12th, sprayed 100 gallons for aphis , using Commercial 30% nicotine 1 to 500. The vines were rolled over and the spray applied to the under side and then the vines rolled back. This was necessary because the lice areon the under side of the leaves. Used at about the same rate per acre as the Bordeaux.

August13th, sprayed 225 gallons on the rest of the patch of which the last 8 rows were treated with bordeaux solution containing nicotine using in all 100 gallons of this kind.

August 15th, vines yellowing in places. Spray has killed a large number of the lice, but a few remain and it remains to be seen how rapidly they will spread. The vines sprayed with the Bordeaux all look well, but all are in need of rain. A few vines look to have the white pickle. All of the water for these sprayings is hauled from the house by the grower a distance of a half mile. The grower also funishes a boy to assist in pumping and manifests his interest in other ways.

August 21st, lice which excaped the spray have mostly been killed by the heavy rains which fell while the vines were rolled over. It will be interesting to observe how soon they will again give trouble. The leaf spot is not apparent as yet as a new infection after the rain. The white pickle is

spreading quite noticeably . Last week only a few vines were affected as evidenced by the leaves, and at a picking then only one or two diseased fruits were found. Now about ten times as many vines show signs of infection and 25 or 30 fruits were found to be affected. This condition was true on both the side untreated with Bordeaux and the side sprayed. The sprayed vines are the most vigorous.

August 21st, sprayed 80 gallons of Bordeaux taking on four new rows at the request of the grower. Vines are in good condition and are setting many blossoms. The sprayed rows are looking much the better and are yielding more. White pickle is present in spots in all of the sprayed rows. An example of the way in which the white pickle is noted in the yield may be seen from the following record.

Saturday picking,10 guarts, white pickle; Monday 32 guarts and Thursday 1$_{0}$ quarts; Saturday 5 quarts.

August 29th, sprayed the patch with 80 gallons. Vines on the sprayed rows are in good condition. Sprayed these rows separately also for lice using 50 gallons of nicotine solution. Turned over all of the rows and will apply nicotine after they have been exposed to the sun for awhile. Leaf spot becoming prevalent on the unsprayed area, and a number of vines have been destroyed. Only a few leaves are affected on the sprayed side and all of these on the last few rows sprayed a week later than the others and adajacent to the unsprayed area.

August 31st, sprayed 100 gallons for aphis on the area not covered by the Bordeaux. Lice are quite bad there again and that portion of the patch has been damaged 75% by the lice

white pickle, and anthracnose, so that a spraying for lice is valueless except as a means of preserving the patch to observe the progress of the anthracnose. Lice in this portion were exposed for two days as the vines were rolled over and also had a heavy rain while in this condition which must have killed a great many.

September 4th, Lice are very scarce now but a number of vines are suspected of being killed by them on the side unsprayed by Bordeaux. Anthracnose and white pickle have also killed a great number of vines on the unsprayed side. On the sprayed side , particularly in the last four rows treated the white pickle is present and the anthracnose in a much lesser degree. Slight frost had turned some of the blossoms white the night before.

September 5th, started spraying but the rain prevented.

Seotember 7th, sprayed 70 gallons on the eight original rows treated. Picking has practically ceased on the remainder of the patch due to injury chiefly from the white pickle, anthracnose, and lice. Sprayed rows although, not bearing heavily on account of the cold are still quite green and show relatively few anthracnose spots. The yield of white pickles is increasing one bushel affected fruits being obtained September 5th. This patch bore out the expectations of the experiment in a great measure.

Disease Description.

The following descriptions are the summary of a number of field conditions taken at a time when it is not definitely known by the observer what the correct diagnosis was. The aim in this description is to tell just how the symptoms appeared and to follow the progress of the trouble in such a way that the untrained observer would be able to identify his observations in the field with some specific trouble described herein.

Disease No.1 Called for convenience "Tip Burn".

Noticeable July 28th. The leaves yellow gradually and then the margins of the leaves turn brown and die back from the tip. Later in the season, the vines wilt down entirely and dry up, but this does not occur for sometime. The effect on the general health and yield of the vine however, is noticeable from the first. The fruit is not affected except in a secondary way. It appears in isolated sections of a patch and seems to spread usually along a row rather than from a center, but it also appears in isolated cases. In the last stages the vine drys up entirely. Same trouble was present in the vicinity last season.

Disease No. 2. Anthracnose (Colletotrioum Lagenarium)

Evidenced in the first stages by small yellowish occasional spots on the leaf. These later turn brown in the center surrounded by a yellowish green ring indicating the extent of infection. These spots rapidly enlarge under favorable conditions, and become confluent on the leaf. The older leaves are usually the first to be attacked and the vine dies from the center. It takes perhaps eight or ten days from the

time of initial infection to spoil the vine although the time may be longer if the weather is very dry, or shorter if it is damp and muggy. Although anthracnose is claimed in disease descriptions to affect the fruit seriously with decayed and sunken spots probably this type of injury does not appear on cucumbers that are picked as young as they are for pickles and this was not observed. The fruit is only affected secondarily in that the vine loses its productive power. This is spreading at present at a very rapid rate considering the dryness of the weather and it is general on nearly all of the patches, those on the sandy soils being affected first. The sprayed portions resist successfully serious infection although a number of leaves are some times spotted slightly.

The first signs of this disease were noted on a patch July 21st in one corner on a few vines. This spread steadily and in spite of the dry weather by August 8th fully 50% of the vines show a spotting of the leaves and in the corner where it started about 5% of the patch was destroyed in that time. On all of the badly infected vines the stems also show lesions from a spot up to an inch in length, even in some dases almost girdling the stem. In the final stages the leaf spots become confluent and the affected leaves die beginning with the older thus giving the appearance from the center of the hill outward. Moist muggy weather seems to be the most favorable for its spread.

Disease No. 3. White pickle.

Primarily a disease of the fruit although the foliage shows typical symptoms. The leaves turn a mottled yellow gradually and often the leaves have yellow margins. There seems to be two distinct types of foliage effect. In the first the leaves merely turn yellowish gradually as described above and the vine shows a general weakness as if from malnutrition. The vine may remain in this way for a long time without further effect except that the vine slowly loses its productive power and the few fruits that are borne are typically diseased. In the second type of foliage injury the leaves become thicker a darker green and more crinkly with sometimes veins and margins tinged with yellow. These kind of vines very soon become unproductive and the plant remains dwarfed and green. There is a difference in the appearance of the diseased fruits on these two types of vines. In the first type the fruits are usually quite smooth and white with prominent green warts scattered on the surface, while in the second type of foliage symptoms the fruits become mare knarled and malformed with very large and numerous dark green warts and not so much of a tendency to whiten. This type could scarcely be truthfully be called a white pickle. No definite cause is known for this trouble nor has any satisfactory explanation been advanced. Professor Jones of Wisconsin indicated that it might be the physiological result , but it remains to be discovered what condition induces this physiological result, and to advance some logical explanation for the reason of its virulent contagious nature. The nammer of its dissemination unknown, but there is no question but that it spreads with great rapidity in some

cases and seems to have an epidemic nature in some regions appearing again the following season at about the same time and place. It appears on all types of soil and under all types of cultivation so it is difficult to associate it with any cultural practice. Bordeaux proved to be no factor whatever in the control of white pickle. It appears on new land never before planted to cucumbers and far removed from any patches the previous year. Seed, however, is all supplied from the same sources and yet relatively few of the regions have had the trouble as yet. The trouble seems most analyhous to the description of peach yellows, having the same mysterious and unexplanable methods of dissemination. It is a trouble much to be feared and whether it is pathogenetic or not it exerts a serious effect on the pickle business in the regions affected reducing the yield more and more each year. The trouble not only reduces the yield, but the so called white pickles do not take the brine and are therefore worth nothing and rejected by the salting station. There is an opportunity for much careful experimentation on the white pickle.

Aphide Injury.

The green aphis were very prevalent around princeton in the season of 1914, and did a vast amount of damage. In fact they made it almost impossible to obtain any conclusive results on the fungous control experiments on account of the damage they did to the experimental patches. Infestation is not commonly noticed at first until a badly infested leaf shows a curl and a darkening. The ground underneath often is covered with the sticky exudation honey dew and usually ants are present and may be a factor in their rapid spread

to other leaves and patches. In the advanced stages the entire under side of the leaf is covered, with adult winged insects, lighter green wingless young and light yellow eggs. The spread is very rapid and usually when a few vines show a badly infestation it is evidence enough that they are present in a slighter amount throughout the entire patch. They can be controlled by a thorough spraying of nicotine solution in the proper strength, quite successfully. As it is necessary to touch each insect with the spray the vines must be rolled over so as to expose the under surface of the leaves where the insects alwaysare. Of cource it is impossible to expose all of the leaves at any one application but by this method with 80 to 100 pounds pressure about 75% ot 80% of the aphis can be killed at the first application and by careful attention can be held in check.

They seem to be specially prevalent in dry weather and on vines weakened by drought or other causes. They are apparently partly controlled naturally by continued cold or heavy rains. Bordeaux is not a check or even a repellent. In fact they seem to prefer the Bordeaux coated leaves. The effect on the vines is very disastrous. In the first stages they weaken the vine and reduce the yield by sucking the juices. Later the badly affected vines die very suddenly giving a shriveled blackened appearance as of a heavy frost.

Spray Injury.

The amount of spray injury done by Bordeaux is an open question. Some authorities clain a decided injury, and some assert none at all. It is difficult outside of experimental plots to get accurate record of relative yield,which do not become affected by the numerous other factors mentioned above.

Since the many factors do not act equally, one would not be justified in making conclusions without particular experimentation. From the observations of this summer I do believe that Bordeaux 3-6-50 does cause some injury to the blossoms either in its effect on the pollen or stigma, or in an action as a repellent to fertilizing insects. I have no statistics on this point to prove it but growers generally have complained that after spraying the yield fell off noticeably on that side for a few days. In a count made of five vines on each side I found that there were two more cucumbers on the sprayed vines and I append a table showing the yield varies scarcely at all. Neither of these results prove anything definitely however, and theroretically it would certainly seem that spraying in bloom would have a detrimental influence. There are so many varying factors affecting the yield that many experiments would have to be made to justify a definite statement.

Spray injury is relatively slight at the most compared with the effect of the disease, and undoubtedly would be offset many times by the preventitive effect of the spray in the case of anthracnose or angular spot being present in the patch in sufficient amount to decrease the yield, but where the troubleswhich are present cannot be controlled by spraying such as the white pickle or if no measures are taken against the lice which are even more destructive, the result of spraying not considering its cost is a loss or at the best a draw. In this event it must be charged as a form of insurance. The mechanical injury from spraying compels attention in certain cases. When the weather is hot and dry the effect of spraying wilted plants which are already suffer-

ing from want of water is very harmful. Whether this is due to the force of the spray, to the cold water, or to the increased transpiration is a question, but the fact remains that it is unsafe and unpracticable to spray vines in this conditi on.

prevalence of disease in the Region.

The diseases observed in the course of the season were:- White Pickle, Anthracnose, Angular Leaf Spot, and the insect Green Aphis. I will take these up in the order of their importance and give a short sketch of the conditions under which they existed.

White Pickle.

This is by far the most serious disease of the region, both in its destructiveness on the crop , but also on account of the mysterious nature of its appearance and lack of any control measure. Out of the 17 patches experimented upon white pickle was present and was an importance in the death of 15 patches. In the survey made of the conditions around Baraboo about fifty miles South of Princeton white pickle was found to be present in almost every patch and a very serious factor in many of these . The disease had become more serious every year and was practically making a successful season impossible.

Green Aphis.

These insects certainly deserve at least a second place among the most important troubles. They were so sudden in their effect and so rapid in their spread that in the patches in which they were serious they were much more destructive than all of the other diseases combined. They were an important factor in the destruction of 7 of the 17 patches,

and in several cases were the sole factor of their destruction so early in the season. Careful watch should be kept on the patch and when they first appear cover the infested vines with soil without pulling it up. If the lice have a start however, a thorough spraying with nicotine repeated if necessary is an efficient control. It is necessary to roll over the vines in order to reach the insects on the under side of the leaves.

Anthracnose.

This is the only truly fungus disease which appeared in the region and it was toward this type of trouble that Bordeaux is a remedy. Anthracnose was only serious in the destruction of nine, but in only two of these was it the most important factor. When the other agencies of destruction permitted of a comparison between the sprayed and unsprayed rows it was found that Bordeaux affected almost a complete control a few sprayed leaves being spotted, but not of sufficient amount to effect economic damage. This disease was also present in some degree around Baraboo.

Angular Leaf Spot.

Experiment stations have not as yet definitely outlined the cause of this disease. It is very difficult at first to distinguish it from anthracnose as the spots are very similar in appearance. The angular spot has a tnedency to follow the veins and the spots are smaller and do not become confluent. They usually are more white in color. In many patches this disease existed at the same time and often on the same leaves as the anthracnose. It does not spread as rapidly but has a serious effect on the nutrition of the vine especially at the center of the hill. Bordeaux seems to control it to about the same degree that it does anthractose. It was very

prevalent around Princeton, Ripon, and Baraboo, and although only totally destructive in a few cases , its effect direct, and indirectly are worthy of consideration.

Key to Pach Record Summary.

A - Anthracnose. W.P. - White Pickle. A.S. - Angular Spot. Aphis refers to the plant lice, drought to the long continued dry period in July, and Cold to the low temperature in early September. In addition to the Bordeaux 700 gallons of nicotine were used to control aphis.

Cost of Spraying will be shown
in a separate table.

- General Effects of Spraying and Recommendations. -

1. Bordeaux 3-6-50 proved to be an effectual ecomic control for the anthracnose and angular leaf spot. It is not an absolute preventitive but if applied to the vines before the disease appears it will prevent any serious infection. If applied after the disease has appeared on the vines it will check its spread in large measures. In case the check rows were not in the patch and the entire patch were sprayed the rate of control probably would be almost complete.
2. Bordeaux 3-6-50 will control angular leaf spot in the same degree as it will anthracnose.
3. When either or both of these diseases appear in the vicinity spraying begun at that time will protect the patch.
4. It is necessary to keep the leaves covered in order to insure protection. The intervals of spraying should be regulated by the growth of the vine. Usually sprayings should be made at intervals of a week or ten days.

5. Do not spray when the vines are in a very wilted condition in a time of drought.

6. Bordeaux is not a repellent nor will it in any way protect the vines against the green aphis.

7. Nicotine solution applied according to directions is an efficient control for aphis. The vines must be rolled over in order to reach the insects on the under side of the leaf with the spray. The spray must hit an insect to kill it.

8. Watch for the first appearance of the aphis and begin control measures as soon as they appear. This may be done at first by covering the infested vines with soil in the row.

9. White pickle is not controlled or checked by the application of Bordeaux in any way. It does not pay to spray a white pickle infected patch.

10. White pickle seems to be contagious.

11. Spraying does not need to begin until the disease appears in the vicinity, and that in some seasons may result in no spraying at all.

12. Spraying is a good insurance against fungus diseases and will pay in all cases where there are only controllable diseases to deal with, considering it as insurance, and in seasons when such diseases are sericus will amply repay the cost.

13. When no disease is present in the patch the sprayed vines will undoubtedly yield less than the unsprayed and not considering the cost involved the operation would be at a loss.

14. In order to secure the best results experimental plots should be owned or absolutely controlled by the party conducting the experimentation.

15. Spraying can be done by the individual grower or better by a combination of several growers, dividing the cost of the outfit at a cost of approximately $35.00 per acre per season, including labor over a full period of eight sprayings. This amount would be materially reduced if the patch only required four or five sprayings, which is more nearly the average.

16. From 150 to 200 gallons per acre should be applied per acre under average conditions.

17. A good day's work for two men using a barrel sprayer drawn by a horse, and operating one lead of hose, will be on the average not more than two acres a day.

Big Rapids , Michigan, is located in Mecosta County , about 75 miles north of Grand Rapids. It is the center of a former lumbering district. While this industry was in progress the size of the town increased to about 15,000. However, since lumbering was necessarily stopped, the town has remain- the same size. It seemed to be fairly prosperous due to the other industries it has taken up.

Farming is almost entirely the occupation of all sides of Big Rapids. The type of farming in most all of the cases is of a low grade, although some of the farmers were quite intelligent and successful . The majority of the farms were small, ranging from five to ten acres to 30 or 40 acres. The main crops raised were corn, oats, rye, some potatoes and cucumbers. The crop yields in practically all cases were very low partly due to the poor methods of farming and partly to the character of the soil. It might be said here that there were a very few farmers that understood the principals of farming and were making a good success of the business. This class of farmers were mostly Germans, while the remainder consisted of nearly all nationalities.

Back about eleven years ago, the H.J. Heinz Company, built a salting station at this town and started contracting for acreages of cucumbers. It did not take long to show the farmers in the vicinity that there were big possibilities in this crop. For the first six or seven years the productions were enormous and the profit to the farmers was large. The price paid the farmer was about $0.50 per bushel for the first grade pickles. At this time most of the farmers within a radius of 10 or 12 miles grew cucumbers, some of them making

it their only crop. Very often those growing pickles yet, would remark about what large crops they used to raise and say that they made more money by far then with the price at $0.50 per bushel than they do now with the price at $1.00 per bushel. The reason for this is almost entirely due to lack of production per acre. The company will not accept as many pickles as they did with the price low, in other words they sort very close.

The reason for the price being advanced was the fact that four or five years ago the production per acre began to decrease and the acreage also decreased due to this cause. In these last few years referred to so many of the growers gave up growing cucumbers that the company did not use more than 1/3 the capacity of the salting station. Why the same number of acres would not produce as many cucumbers as formerly is hard to account for. It possibility might be due to the general light soil conditions. During this time, there had been poor rotation of crops and possibilly growing cucumbers in succession might give tonic conditions to the soil. Several growers gave what they considered very much better culture to the crop in these years and yet would be able to get only perhaps 1/2 or 1/3 the former yield. This was naturally a problem that perplexed the conscientious grower, the grower that wanted to raise cucumbers, and liked the crop.

Another thing that tended to lose growers for the company was the appearance of disease three or four years ago in this district. Although not as serious as in some

sections it was the source of more uncertainty in the growing of this crop. The term used by the grower for all diseases was in all cases "blight". They were not observing enough to tell that there were different kinds of disease. In talking with the majority of growers in the summer of 1914 it was evident that they did not regard disease as serious as the lack of production. They thought that if they could get as large yields as they did when the business first started they could afford to have some disease. Disease, however, in the season of 1914 was more serious than it had been in the past years and probably will be the cause of a large number of the 1914 growers giving up growing this crop.

In other sections where the Heinz Company has cucumber growing districts the disease was causing large amounts of damage and so for this reason they desired to find out the control for the various cucumber diseases. As has already been stated they desired to have as many climatical regions included in the experiments as possible, hence the carrying on of the experiments at Big Rapids.

Spraying was a very new thing for the majority of the growers, but when they were informed that the Company was advocating the operation they were willing to try it. It seemed to be the general feeling that anything the Heinz Company did was all right. Many of them said in requesting them to let us conduct spraying experiments on their patches, that if it proved a damage to their crops the Company would pay for any loss willingly. It was a striking thing that in all cases it would have not been possible to conduct the experiment in their patches if it would cause them any expense.

It was necessary before starting the spraying to go to

a dozen growers on all sides of the town and get their permission to spray their patches. They were to furnish water and to pump the sprayer. Some were somewhat enthusiatic over the spraying while others were rather skeptical but finally consented to try out the plan. The total number of patches that were given at least one spraying were seventeen.

The apparatus used was the same as is listed in the introduction of this thesis, with the exception of a moveable arm 5" long attached to the cylinder of the pump and serving to hold the hose over the wheel and also to prevent it from injuring the vines. The ground was very lightsand in a large number of cases and to prevent the filled barrel from causing the ground support to sink into the soil a wide shoe was attached.

The Bordeaux used in the experiment was made in the following way. The stone lime of a high grade as obtainable was slaked before the time to spray, usually enough to make four or five barrels being slaked at one time. Very much care was used in slaking in order to prevent burning or drowning. This solution was the concentrated lime solution. The copper solution was dissolved in a concentrated solution before the time of spraying. When ready to spray enough of the concentrated solutions of both the lime and the copper sulphate were separately diluted to make 25 gallons of each. This done, the two were poured into the sprayer at the same time to give as good Bordeaux as possible. With the exception of a very few cases the Bordeaux was used the same day as prepared. Water for the dilutions was pumped as long as possible before it was wanted for use, thus preventing any chance fo chilling the plants with cold water.

Spraying was done as close as possible every week or ten days. In a few instances it was impossible to get the farmer to spray when that spraying should have been put on. The upper surfaces of the vines were well sprayed. It was found impractical and almost impossible to spray the under surface of the vines.

Record of Individual Patches..

Mr. Vandenburg - patch No. 1.

Acreage: Total 1.25 acres, sprayed .625 acre.

Planted: About May 27th.

Soil: Sandy, mostly new ground.

Culture: Good.

1st spraying.

Date: July 30th, 1914.

Conditions: The patch was in very good shape. Plants were healthy with the exception of a few that had bacterical wilt.

Weather: Very clear and hot.

Spray: 5-6-50 Bordeaux, amount 75 gallons.

Vandenburg refused to allow the second spray to be put on. He was a very queer old man, and imagined that one spraying ought to be sufficient for the season.

Disease: August 25, 1914 , patch was abandoned on account of cucumber scab. This man gave the patch very good culture, but he neglected to keep the cucumbers from getting large.

W. J. Roades, Patch No. 2.

Acreage: Total .37 acre, sprayed .18acre.

Planted: About June 30th.

Soil: Sandy, new ground that season.

Culture: Fair.

1st spraying.

Date: July 20, 1914.

Conditions: Late planting caused very small plants, most of them had not started to run. The row on the back furrow was large due to the presence of more available plant food.

Weather: Clear , hot.

Spray: 3-6-50 , amount 35 gallons.

2nd spraying.

Date : July 29, 1914.

Conditions: Normal growth. Did not show any bad effect of the previous spraying.

Weather: Clear, but not hot.

Spray: 3-6-50, amount 50 gallons.

3rd spraying.

Date: August 6, 1914.

Conditions: Vines had made a very good growth. The sprayed side seemed to make a better growth than the unsprayed.

Weather: Partly cloudy, warm.

Spray: 3-6-50, amount 35 gallons.

4th spraying.

Date: August 17, 1914.

Conditions: The vines appeared in better health and had grown better than the unsprayed. It is probable that the soil conditions were responsible for this, as I can see no reason for the spray causing a better growth.

Weather: Clear, warm.

Spray: 3-6-50 , amount 50 gallons.

This patch was dropped because of lack of time, and no more spraying were applied.

Disease: No disease was observed until 8/29/14, when scab

was found . It was not possible to get the percent of disease present at this time. On 9/2/14, the patch was abandoned on account of scab. Mr. Roades stopped picking the unsprayed portion of the patch before the sprayed about a week, which showed that the sprayed had been continued, it would probably have prevented the disease longer.

No shortage of yield was reported in this patch, although the leaves were somewhat yellowed at times during the season.

Mr. E. C. Moore - Patch No. 3.

Acreage: Total 1.07 acre, sprayed .53 acre.

Planted: About May 28th.

Soil: Light sandy loam.

Culture: Excellent.

1st spraying.

Dates: July 20 and 21, 1914.

Conditions: The vines in this patch had made a very good growth, and appeared in very good health except for a slight attack of bacterial wilt.

Weather: Clear, and warm on the first day; cool on the second.

Spray: 3-6-50 , amount 90 gallons.

2nd spraying.

Dates: July 27 and 28, 1914.

Conditions: Spraying was done just after the leaves had had time to dry after a hard rain. Pickles were picked after spraying. Finished the next day.

Weather: Cloudy the first day; clear the second day.

Spray: 3-6-50, amount 100 gallons.

3rd spraying.

Date: August 4, 1914.

Conditions: The sprayed vines have not made as good a growth

as the unsprayed, neither do they look as healthy. Only the upper surface was sprayed at this time.

Weather: Clear, hot.

Spray: 3-6-50, amount 80 gallons.

4th spraying.

Date: August 14, 1914 and August 15, 1914.

Conditions: The vines that were not sprayed continued to show better growth and appeared healthier.

Weather: Clear, cool and clear.

Spray: 3-6-50, amount 120 gallons.

Disease:

8/7/14 - 6 to 7 cucumbers affected with scab were found, but it was not known from which side they came from.

8/8/14 - found 3 affected with scab.

8/15/14 - % of scab on the sprayed 12 to 15%.

" " " " " unsprayed 39% (From 298 pickles)

8/19/14 - " " " " " sprayed 22%

" " " " " unsprayed 36% (actual count)

8/24/14 - Unsprayed abandoned.

8/26/14 - Sprayed " .

Moore would not spray the 4th time when I wanted him to and thus between the 3rd and 4th sprayings there was lapse of 10 and 11 days, followed by very heavy rains. If this spraying had been made the 7 days after the previous one I think the disease would have been controlled to a greater extent. It is probable that the very damp weather had a large part to do in the loss of the patch.

During the entire season this patch showed much better condition of vines regarding growth especially on the unsprayed side. The stunted condition of the vines was borne out by

the fact that the unsprayed yielded less.

Mr. M. Nels Larson. Patch No. 4.

Acreage: Total 1.28 acres, sprayed .65 acres.

Planted : June 6 or 7th.

Soil: Sandy.

Culture: Fair.

1st spraying.

Date: July 21st, 1914.

Conditions: Fair plants. Small growth due to slowness of coming up. Said to have been three weeks coming up.

Weather: Clear, warm,

Spray: 3-6-50, Amount 65 gallons.

2nd spraying.

Date: July 28, 1914.

Conditions: Vines have made a normal growth during the week, the unsprayed are probably a little larger.

Weather: Clear, windy, warm.

Spray: 3-6-50, 56 gallons.

4th spraying.

Date: August 13, 1914.

Conditions: Growth normal. No difference insprayed and unsprayed plants.

Weather: partly cloudy, warm.

Spray: 3-6-50, amount 140 gallons.

3rd spraying.

Date: August 5, 1914.

Conditions: Very large growth during the week.

Weather: Clear, hot.

Spray: 3-6-50, amount 70 gallons.

5th spraying.

Date: August 24, 1914.

Conditions: Growth normal, and equal for both sides.

Weather: Partly cloudy, warm.

Spray: 3-6-50, amount 130 gallons.

Disease:

No scab was noticed until 8/17 when about 1/2 dozen pickles were found affected with the scab. On 8/24 the following determinations were made:-

% of scab on the unsprayed side - 65%

% " " " " sprayed " - 15%.

Mr. Larsin said at this time that he would not pick the unsprayed if they continued as bad as they were on this date. When next observed, 8/27 the scab was getting very serious on the whole patch with the following percents.

% on the unsprayed side --- 70%

% " " sprayed " --- 40% to 50%.

This shows that the scab on this date was nearly as bad on the sprayed as on the unsprayed. When this disease first appeared Mr. Larson took much pains to remove all the affected pickles from the patch, but this means of control was not successful. The spread of disease to the sprayed in this patch is accounted for in the fact that the unsprayed was very badly infected and for two days previous to the worst infection on the sprayed the wind blew continously from the unsprayed side. Spraying, however, partially controlled for when he stopped picking the sprayed portion nine days after he stopped picking the unsprayed the % of disease on the sprayed did not equal the unsprayed side.

Mr. Wm. Libby - patch No. 5.

Acreage: Total .25 acre, sprayed .125 acre.

Planted: May 28th.

Soil: Dark sandy loam.

Culture: Good.

1st spraying.

Dates: July 21 and 22, 1914.

Conditions: Very fine growth and apparently healthy.

Weather: Clear and very warm on the 21st and clear and warm on the 22nd.

Spray: 3-6-50, amount 25 gallons.

2nd spraying.

Date: July 29, 1914.

Conditions: Vines in very good conditions and growth good.

Weather: Clear, cool.

Spray: 3-6-50, amount 30 gallons.

3rd spraying.

Date: August 8, 1914.

Conditions: Normal , sprayed vines have made as good growth as the unsprayed.

Weather: Partly cloudy , warm.

Spray: 3-6-50, amount 30 gallons.

4th spraying.

This patch was dropped as there was a lack of time and its distance from the source of supply was so great.

Disease:

This patch even tho it was within 1/4 mile of one ; 1/4 mile southwest of another; and 1/4 mile southeast of still another, all of which were heavily infected with scab remained free until September 2, when it first began to appear.

Frost killed the patch. Ithad continued to get good yields until this time.

The sprayed portion seemed to have a greener appearance, although the leaves of the sprayed seemed stiffer.

Mr. Canaan. Patch No. 6.

Acreage: Total .25 acre, sprayed .125 acre.

Planted: About June 30th.

Soil: Light sand.

Culture: Good.

1st spraying.

Date: July 21, 1914.

Conditions: This patch showed the lack of plant food. The plants were very small and spindling. The south end vines were the most vigorous.

Weather: Clear , hot.

Spray: 3-6-50, amount 15 gallons.

2nd spraying.

Date: July 28, 1914.

Conditions: Growth normal through the week. The Plants that were weak and backward seem to be making a better growth.

Weather: Clear and cool.

Spray: 3-6-50, amount 15 gallons.

3rd spraying.

Date: August 5, 1914.

Conditions: Some of the vines especially on the south end have made a good growth. No pickles have been picked from this patch yet.

Weather: Clear and hot.

Spray: 3-6-50, amount 15 gallons.

4th spraying.

Date: August 14, 1914.

Conditions: Fair growth and about equal on both sides.

Weather: Clear and cool.

Spray: 3-6-50, amount 35 gallons.

5th spraying.

Date: August 24, 1914.

Conditions: The sprayed half made during the week a much better growth then the unsprayed. This fact is probably due to more fertilizer on this part of the patch.

Weather : Clear and cool.

Spray: 3-6-50, amount 40 gallons.

6th spraying.

Date: Deptember 3, 1914.

Conditions: The sprayed half was greener and more vigorous in appearance. Growth for the same reasons as given under the 5th spraying.

Weather: Partly cloudy, cold.

Spray: 4-6-50, amount 40 gallons.

Disease: Scab appeared on this patch on 8/24, when two affected pickles were found. Canaan was instructed to remove all diseased pickles from the patch, which he did. On 9/3 scab was present on both sides to the extent of 40 or 50%. The vines were very thick and partly account for the spread of the scab to the sprayed. The patch was abandoned on 9/5 on account of the disease and the lack of production. This patch was located nearly directly west of Larson's patch, which wasabout 40 rods distant. At the time disease appeared seriously a strong wind blew from Larson's . This may partly account for the infection.

Martin - Gruntz - Patch No. 7.

Acreage: June 4 or 5th.

Soil: Sandy loam.

Culture: Very good.

1st spraying.

Date: July 21, 1914.

Conditions: This patch was developed very well, probably have as well advanced vines as any in the locality. Had a very healthy appearance.

Weather: Clear and hot.

Spray: 3-6-50, amount 40 gallons.

2nd spraying.

Date: July 28, 1914.

Conditions: Vines still making an excellent growth. No signs of poor results from the previous spraying.

Weather: Clear and cool.

Spray: 3-6-50, amount 45 gallons.

3rd spraying.

Date: August 7, 1914.

Conditions: Vines still continued to make a very good growth and the sprayed appeared in as good conditions as the unsprayed, regarding results from spraying.

Weather: Clear and hot.

Spray: 3-6-50, Amount 50 gallons.

4th spraying.

Date: August 14, 1914.

Conditions: Growth equal on both sides.

Weather: Clear and cool.

Spray: 3-6-50, amount 70 gallons.

5th spraying.

Date: August 25, 1914.

Conditions: Normal growth of vines on both sides.

Weather: Clear and cool.

Spray: 3-6-50, amount 90 gallons.

6th spraying.

Date: September 3, 1914.

Conditions: The unsprayed was abandoned at this time. The sprayed portion was beginning to show effects of the seasons production. This patch producted very good during the season.

Weather: Partly cloudy and cool.

Spray: 4-6-50, amount 80 gallons.

Disease: On 8/15 the scab appeared on 4 or 5 hills on the unsprayed. It increased on the unsprayed until on the 8/27 when the % on the unsprayed was 75% while the % of scab on the scab sprayed side was 5%. The unsprayed sides were not picked after this date an account of the disease. The sprayed side continued comparatively free from scab (9/3 10%) until the frost stopped picking on 9/7.

Mrs. E. J. Smith - Patch No. 8.

Acreage: Total .41 acre, sprayed .20 acre.

Planted: About June 5th.

Soil : Light sandy.

Culture: Fair.

1st spraying.

Date: July 22, 1914.

Conditions: Growth of plants fair. The south end was the best part of the patch.

Weather: Clear and partly cloudy.

Spray: 3-6-50, amount 35 gallons.

2nd spraying.

Date: July 30, 1914.

Conditions: Growth of vines still continues to be very good. There was no apparent injury from the previous spraying.

Weather: Clear and warm.

Spray: 3-6-50 , amount 40 gallons.

3rd spraying.

Date: August 7th, 1914.

Conditions: Growth on the sprayed and the unsprayed seemed about the same, however, the sprayed portion seemed healthier .

Weather: Clear and hot.

Spray: 3-6-50, amount 35 gallons.

4th spraying.

Date: August 18, 1914.

Conditions: The sprayed still remained better in vigor and seemed to indicate more growth than the unsprayed.

Weather: Partly cloudy and warm.

Spray: 3-6-50, amount 45 gallons.

5th spraying.

Date: August 26, and 27 , 1914.

Conditions: Growth fair and about equal for the two sides.

Weather: Partly cloudy, cool, threatening, and partly cloudy and cool the second day.

Spray: 3-6-50, amount 62 gallons.

6th spraying.

Date: September 3, 1914.

Conditions: The sprayed vines looked greener and more vigorous then the unsprayed.

Weather: Cloudy and cold.

Spray: 4-6-50, amount 50 gallons.

Disease: The first that disease was noted was on 8/13 when two or three pickles affected with scab were noted. The scab on the unsprayed side increased to 15% on 8/26 and 33% on 9/3 while on 8/18 the % scab on the sprayed was 3 to 5% which increased to 10% on 9/3. The frost was the cause of stopping picking.

Mr. A. R. Irish. - Patch No. 9.

Acreage: Total .14 acre, sprayed .06 acre.

Planted: May 23rd.

Soil: Sandy loam previously an old hog lot.

Culture: Good.

1st spraying.

Date: July 22, 1914.

Conditions: This was a very small patch but in excellent stage of growth and apparently very healthy . Had started to pick cucumbers at this date.

Weather: Clear.

Spray: 3-6-50, amount 16 gallons.

2nd spraying.

Date: July 30, 1914.

Conditions: Growth continued excellent and no shortage in the yield of the sprayed side reported.

Weather: Clear and warm.

Spray: 3-6-50, amount 2$\frac{1}{2}$ gallons.

3rd spraying.

Date: August 7, 1914.

Conditions: Vines continued to make a very good growth, hogs in the patch did some damage to the sprayed portion.

Weather: Clear, cool.

Spray: 3-6-50, amount 2$\frac{1}{2}$ gallons.

4th spraying.

Date: August 14, 1914.

Conditions: The sprayed vines have made a good growth as the unsprayed.

Weather: Clear and cool.

Spray: 3-6-50, amount 30 gallons.

Disease: Stopped picking on 8/24 due to scab. The % on the sprayed was 15% while on the unsprayed it was 60%. This showed very much more on unsprayed, but due to the smallness of the size of the patch it did not pay to pick the sprayed side.

Mr. Schramm - Patch No. 10.

Acreage: Total .51 acre, sprayed .24 acre.

Planted: about June 5th.

Soil: Light sandy.

Culture: Fair.

1st spraying.

Date: July 22, 1914.

Conditions: Small plants and very uniform. The poorest half was sprayed.

Weather: Partly cloudy.

Spray: 3-6-50, amount 15 gallons.

2nd spraying.

Date: July 28, 1914.

Condition: Fair growth.

Weather: Partly cloudy, hot.

Spray: 3-6-50, 20 gallons.

3rd spraying.

Date: August 8, 1914.

Conditions: Vines continued to make a fair growth.

Weather: Partly cloudy,, hot.

Spray: 3-6-50, amount 25 gallons.

4th spraying.

Date: August 19, 1914.

Conditions: The lower or the sprayed half was not as vigorous as the upper half. Poor soil was the cause for the lack of growth in this patch.

Weather: Cloudy, warm, threathening.

Spray: 3-6-50, amount 40 gallons.

Disease: Scab was said to have appeared in this patch as early as 8/8 as reported by a neighbor. On 8/19 the % of scab on the unsprayed was 13% while there was none on the sprayed. The patch was abandoned on 8/27. % scab on unsprayed 75% and on the sprayed less than 15%. Shramm stopped picking because it did not pay to pick only the sprayed side as this patch was very unproductive in the first place.

L. J. Stokes. - Patch No. 11.

Acreage: Total .42 acre, sprayed .22 acre.

Planted : June 7th.

Soil: Light and sandy.

Culture: Fair.

1st spraying.

Date: July 23, 1914.

Conditions: Vines were fairly vigorous at this date. Stokes said wind bothered him in previous years and so this year he planted beans between the rows to protect them.

Weather: Hot and sultry.

Spray: 3-6-50, amount 40 gallons.

2nd spraying.

Date: July 30, 1914.

Conditions: Growth very good during the week. Appeared healthy

Weather: Clear and warm.

Spray: 3-6-50, Amount 40 gallons.

3rd spraying.

Date: August 8, 1914.

Conditions: Vines on this were very badly wilted due probably to the beans planted in the rows.

Weather: 3-6-50, amount 40 gallons.

4th spraying.

Date: August 19, 1914.

Conditions: Spraying was made from two different barrels of Bordeaux. Growth normal, and equal on both sides.

Weather: Cloudy, hot, and sultry.

5th spraying.

Date: August 27, 1914.

Conditions: Growth normal and equal on both sides.

Weather: Partly cloudly.

Spray: 3-6-50, amount 45 gallons

6th spraying.

September 3, 1914.

Conditions: Growth has practically stopped. The vines on the sprayed seemed greener and contained more water than the unsprayed.

Weather: Partly cloudy, cold.

Spray: 4-6-50? amnount 45 gallons.

Disease: When 4 or 5 pickles infected with the scab were found 8/22 the vines and pickles were destroyed. However, on

8/27 the % of scab on the unsprayed was 30% and on the sprayed was 10%. The unsprayed continued to get worse until 75% were infected while on this same date 9/1, the sprayed showed only 5% infected with this disease. Picking was stopped by the frost 9/8.

Dwight - Lily - Patch No. 12.

Acreage: Total .88 acre, sprayed .46 acre.

Planted : About June 5th.

Soil: Sandy loam, quite fertile.

Culture: Good the first part of the season, but weedy during the last part of the season.

1st spraying.

Date: July 23, 1914.

Conditions: Plants in very good condition as to health and growth.

Weather: Very warm, clear.

Spray: 3-6-50, amount 75 gallons.

2nd spraying.

Date: July 31, 1914.

Conditions: The growth seemed to be equal on both sides.

Weather: Clear, warm.

Spray: 3-6-50, amount 50 gallons.

3rd spraying.

Date: August 11, 1914.

Conditions: Vines have made a normal growth. Sprayed were equal to the unsprayed in growth.

Weather: Cloudy and cool.

Spray: 3-6-50, amount 110 gallons.

4th spraying.

Date: August 20, 1914. and 21, 1914.

Conditions: The vines seemed to have made as much growth on the sprayed as on the unsprayed. Patch at this date was extremely weedy .

Weather: Cloudy, warm and clear and warm.

Spray: 3-6-50, amount 125 gallons.

5th spraying.

Date: August 28, 1914.

Conditions: Growth very good and about equal on both sides.

Weather: Cloudy , and cool.

Spray: 3-6-50, amount 125 gallons.

6th spraying.

Date: September: 4, 1914.

Conditions: Growth not rapid and best on the sprayed side.

Weather: Clear and cool.

Spray: 4-6-50, amount 110 gallons.

Disease: Scab did not gain a foothold on this patch. On 8/22, one pickle infected with scab was found and on 8/28 less then 1/2 dozen were found that had scab. On 9/4, the scab on the unsprayed side was 5%, while on the sprayed side it was .1% . The frost killed the patch.

There was considerable "Angular Leaf Spot" in this patch. Observation showed that this disease was controlled by Bordeaux spray. On 9/4 about 30 or 40% of the plants were affected with this trouble while there were only 3 or4 plants affected which showed signs of it.

Mr. A. Langworthy, - Patch No. 13.

Acreage: Total .316 acre, sprayed .14 acre.

Planted: May 25th,

Soil: Sandy clay loam, very rich.

Culture: Very good, plants too thick.

1st spraying.

Date: July 23, 1914 and 24th, 1914.

Conditions: Plants very vigorous and of large growth. Far too thick. Picking had already begun.

Weather: Cloudy on first day and clear on the second.

Spray: 3-6-50, amount 30 gallons.

2nd spraying.

Date: August 3, 1914.

Conditions: No difference could be observed between the sprayed and the unsprayed as to growth.

Weather: Clear and warm.

Spray: 3-6-50, amount 30 gallons.

Langworthy took the Bacterial Wilt present in the patch for Bordeaux and refused to make the third spraying.

Disease: The unsprayed side on 9/1 showed 40% of the pickles affected with scab. There was a very slight difference in on the sprayed side. This patch showed that it was necessary to keep up spraying in order to even check the scab fungus. Langworthy said on 8/11 that he was not getting as many pickles from the sprayed as the unsprayed. However, on 8/22 the sprayed vines looked greener and more healthy than the unsprayed.

Mrs. Troupe, Patch No. 14.

Acreage: Total .47 acre, sprayed .23 acre.

Planted: June 10th.

Soil: Clay, sandy loam, quite rich.

Culture: Fair.

1st spraying.

Date: July 24, 1914.

Conditions: Vines were somewhat eaten by insects. Growth was fair.

Weather: Partly cloudy, sultry.

Spray: 3-6-50, amount 30 gallons.

2nd spraying.

Date: July 31, 1914.

Conditions: The sprayed vines were smaller than the sprayed to start with and still smaller at this date.

Weather: Clear and cool.

Spray: 3-6-50, amount 20 gallons.

3rd spraying.

Date: August 11, 1914.

Conditions: Excellent growth of vine during the previous week. Did not show many signs of preceeding sprays.

Weather: Clear and cool.

Spray: 3-6-50, amount 35 gallons.

4th spraying.

Date: August 31, 1914.

Conditions: Equal growth on both sides. Vines at this date were making excellent progress.

Weather: Clear and cool.

Spray: 3-6-50, amount 45 gallons.

5th spraying.

Date: August 29, 1914.

Conditions: Growth very good and apparently equal.

Weather: Clear and cool.

Spray: 3-6-50, amount 50 gallons.

6th spraying.

Date: September 4th, 1914.

Conditions: Growth good and sprayed vines were a little more vigorous than the unsprayed.

Spray: 4-6-50, amount 40 gallons.

Disease: No scab was found in this patch until 8/29, when two or three pickles were found on the unsprayed side. On 9/4 the % of scab on the unsprayed was 1% and only .1% on the sprayed. This patch was probably about 1/2 mile from any other patch that had very much scab, which possibly accounts for the fact this patch did not have much of an infection.

Mr. George Gorden, - Patch No. 15.

Acreage: Total 1.11 acre, sprayed .47 acre.

Planted : June 5 and 6th.

Soil: Clay loam.

Culture: Fair , some weeds.

1st spraying.

Date: July 24th,

Conditions: Vines were fairly vigorous but somewhat uneven in growth.

Weather: Cloudy , threatening.

Spray: 3-6-50, amount 80 gallons.

2nd spraying.

Date: August 1, 1914.

Conditions: Good growth during the week.

Weather: Clear and warm.

Spray: 3-6-50, amount 75 gallons.

3rd spraying.

Date: August 12, 1914.

Conditions: Normal.

Weather: Clear and warm.

Spray: 3-6-50 , amount 90 gallons.

4th spraying.

Date: August 22, 1914.

Conditions: Vines continued to make a good growth, and no difference between the sprayed and the unsprayed.

Weather: partly cloudy, and warm.

Spray: 3-6-50, amount 90 gallons.

5th spraying.

Date: September 2, 1914.

Conditions: Very good growth. The vines in this patch are allowed to run at random as far as is possible. The two sides appear equal in growth.

Weather: Partly cloudy, cool.

Spray: 4-6-50, amount 100 gallons.

Disease: The first case of scab appeared on 8/22, when two or three pickles affected with this trouble were found. These were taken from the patch and destroyed. On 9/1 the unsprayed half showed 10% affected with scab while on the following day the sprayed side had only 3 or 4 pickles affected with this trouble. The same proportions were found on 9/5 when the unsprayed showed 20% scab as against 2% on the sprayed.

Miss Mary Welcome, Patch No 16.

Acreage: Estimated total 1 acre, sprayed .5 acre.

Planted: About June 5th.

Soil: Sandy loam.

Culture: Poor.

1st spraying.

Date: August 4, 1914.

Conditions: This patch will possibly serve as an experiment to see whether spraying later than the other patches in this esperiment will have the same effect.

Weather: Clear and hot.

Spray: 3-6-50, amount 50 gallons.

2nd spraying.

Date: August 17, 1914.

Conditions: Patch very weedy and the growth of the vines not up to normal.

Weather: Clear and warm.

Spray: 3 -6-50, amount 90 gallons.

Disease: This patch was abandoned about 8/26 on account of scab. The sprayed side did not seem to be controlled at all by the two sprayings given it.

- Conclusions. -

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Cucumber scab which is caused by Cladosporium Cucumerinum was very prevalent throughout the entire cucumber growing district about Big Rapids. There were only two patches which did not have serious attack of the disease, among those experimented upon. Many of the patches to the east of the town were abandoned as early as 8/22. This disease does the most damage on the pickles, although it works on the vines causing lesions. On the pickles scab gives more the appearance of rot. In case of very serious attacks the entire cucumber will be covered with the scab though usually it appears only in spots on the pickle. As the pickle matures the scab spots tend to dry up and it is at this time that the disease gives the appearance of scab.

From the results on the various patch conducted at Big Rapids it is evident that the cucumber scab was not completely controlled but was held in check in all instances, where the proper number of sprayings were given. However, the controll in some cases was not sufficient to make it a paying proposition. This high increase of scab on the sprayed was due in the case of patch No. 3 to default of spraying at the proper time. The high rise of disease on Patch Np. 4 on the sprayed vines was probably due to the heavy infection on the unsprayed combined with a strong wind blowing across the sprayed.

Patches as No. 7, 11, and 15 which were average patches in all respects show very plainly the way this disease can be controlled by 3-6-50 Bordeaux applied at the proper times. Results on these patches compared to results on patches that were sprayed only once or twice (1 and 13)

show distinctly that this spray will control scab.

In some cases, it was reported that the spraying decreased the yield while others showed no difference either as to shortage of yield or as to stunting of growth. Vandenburg , Patch No. 1, reported shortage , but did not take any accurate methods to substantiate this statement. Moore Patch No. 3, had shortage as shown by actual measurement and count on test rows. The vines on the sprayed showed a decrease in growth. In Patchess, 2, 4, 6, 7, 8, 9, 11, 12 13, 14, and 15 no shortage was reported from the sprayed. In fact the majority showed better condition of vines.

It is noticeable that wet weather correlates with the appearance of heavy infection in practicall all cases. During five days from August 16 until 21st, the amount of rainfall was 1.83 inches, and warm weather accompanied this heavy fall of rain. In nearly all cases the heaviest infection appeared from August 22, in most cases, to August 29 and 30.

- Recommends. -

It would be advisable for the Company to own their own acreage for the purpose of conducting more accurate experiments. By doing this they would be able to keep accurate accounts of all operations and have a knowledge of all operations, and have better data as a result. It is very hard to do scientific work on plots that belong to people that know nothing of what is being done and suspicion all operations.

Experiments for the control of scab should be conducted where the whole patch was sprayed. It is a personal belief that if the entire patch were sprayed the control would be nearly absolute.

Spraying Experiments at Plymouth.

The spraying experiments in Indiana were conducted in the vicinity of Plymouth, a prosperous town of some five thousand inhabitants about twenty-three miles south of South Bend, in Marshall County. While the town itself is moderately thrifty, the surrounding country is not well adapted to agriculture, the farmers there raising but very mediocre crops, both in quantity and quality. The land as a whole is light, and their principal products are cow peas, wheat, corn, and oats. The farms are usually small, not many of them being above forty or fifty acres in extent, and their owners are not as energetic or up to date as the farmers further south in the state. Orchards are a very great rarity, and the few that are located in the vicinity of Plymouth are in very bad condition through lack of care. Spraying is an unknown art with the great majority of the land owners, which added considerably to the difficulty experienced in obtaining permission from them to conduct spraying experiments in their cucumber patches.

The Heniz Company has maintained a salting station in the town for something over twenty years, and when it was first established, the farmers of the community grew almost rich off thier pickle yields, although receiving only one half as much per bushel as they do at present. It was not an uncommon occurrence at that time for the growers to deliver from two thousand to three thousands bushels of first grade pickles per day. Since then, however, the yields and consequent receipts at the station have been steadily diminishing until the low mark was set during the season of 1914 , when but a trifle over three thousand bushels of first grade

pickles were delivered during the entire season, and but 350 barrels of dill pickles were put up. It was during this season that the following experiments were conducted, and it is unfortunate that they should have been made during such a particularly bad year, for although it was shown that disease could be effectively controlled by spray, the yields were so small in the majority of cases that a very conclusive proof from the growers' standpoint was impossible. In other words, the sprayed plants did not die from disease, but they did not produce enough more than those which were killed to make spraying practical, or a paying proposition. It remains to be proved whether it would be so in a successful growing season.

The cause of this tremendous decrease in yields was a source of great uneasiness to the company. It appears that diseases of various kinds have been prevalent in that region for many years, and have been gradually increasing in severity until the present time, with a consequent decrease in yields. While other factors, such as change in climatic conditions, etc., may have had some influence on this decrease in yield, the company believed that it was mainly due to the killing or weakening of the vines by disease, and the following experiments were attempted to show that these diseases could be efficiently controlled, and the yield consequently increased. The poor yield of the last season was due primarily to unfavorable weather conditions, although several kinds of fungus diseases were very prevalent in the neighborhood, and a disastrous attack of aphis killed many patches in the latter part of August. A scientific study of the diseases found here had never before been made, and for this reason it was diff-

icult to ascertain the exact nature of the troubles which had been affenting the vines in former years. Anything which made the vines die was popularly called "blight" by the farmers, while any insect injury was caused by "lice" , according to the growers. After careful questioning , however, it was pretty well decided that the same diseases, which were found there during the last season had been threr for several years.

It was necessary, first of all, to obtain the good will and cooperation of the growers themselves, to make a satisfactory test of the value of commercial spraying. Some seventeen growers , altogether, were interviewed , and after a careful explanation had been made to each of the exact nature of the work, and what was to be required of them, each, more or less grudgingly gave permission to have work carried on in his patch. Some were very enthusiastic from the first, but the majority were more or less skeptical, being entirely ignorant on the subject of spraying in general and of cucumber spraying in particular. Some of the latter refused to spray after the first attempt, on discovering that the yields did not double immediately on the sprayed portion. Others decided that the spray hurt the vines, decreased the yield, or hurt the hands of the pickers, and refused to spray more than once. Only a minority continued the work during the entire season, and to these faithful ones is due the thanks of the writer. The best results were found of course, on the patches which had been sprayed several times, although those which had to be discontinued were not without their value to the experiment, as several of these showed the beneficial effects of even one application of spray.

The plan of work was as follows:- Heinz Company agreed to furnish the apparatus , material, and operator, to spray one half of each grower's patch with Bordeaus mixture once every week or tem days throughout the growing season, that is, from the middle of July until the first of September of middle of September. In return for this, the grower was to give his time during the application of the spray, by working at the pump, and to give any other assistance required, as well as to furnish the necessary water for mixing the spray. This plan proved to be not entirely advantageous either to the writer, who mixed the spray and handled the spray rod, or to the grower. The latter was often busy at some other work when the time arrived to apply the spray, and naturally disliked to leave it for something which he usually regarded with considerable skepticism. At some times it was necessary to hire a man to do the pumping, and on such occassions it was found that the work was done more quickly and efficiently.

The patches were purposely selected to lie in all directions from the town, so as to offer the greatest selecti on of soils and other conditions, including the prevalence of disease. Dilution barrels, and another of stock lime solution, were left near the water supply at each patch. A barrel of stock copper sulphate solution was carried in a spring wagon from patch to patch, the Bordeaux , made at the strength of 3-6-50 in all cases, being made at each patch just before applying it. The spray cart, rod, nozzles, and other necessary paraphernalia, were towed behind the wagon from patch to patch. As far as poccible, a schedule was adopted which brought the sprayings at each patch a week apart, although climate conditions and inability of the grower to

help at certain times, made necessary the slight changing of this schedule, although no more than ten days were ever allowed to elapse between sprayings.

The stock solutionswere prepared by dissolving fifty pounds of copper sulphate in a fifty gallon barrel full of watter, in case of the copper stock, and of slaking fifty pounds of stone lime , and diluting to fifty gallons of water, in case of the lime stock. Great care was taken in using only fresh, pure materials in the preparation of these solutions. On arriving at a patch, three gallons of the stock copper solution were accurately measured out, and poured into one dilution barrel, each of which held fifty gallons. This quantity of copper was then diluted to twenty-five gallons with water. Six gallons of stock lime were then poured in to the other dilution barrel, and this diluted to twenty five gallons with water. Using the spray rig as a mixing barrel, and filtering through a fine mesh copper strainer, the two dilutions were poured simultaneously together, making an exceklent mixture , which was afterwards tested with a drop or two of ferrous cyanide. In spraying, an endeavor was made to keep the pressure at eighty pounds, and this average was well maintained, although it sometimes varied above or below the mark.

The front of the spray rig was fitted with a single tree, to which a horse was hitched, making it very convenient to drive through the patch. In all cases the rows were planted sufficiently far apart to enable the spray rig to pass between them. Three rows were sprayed at once. For example, suppose the spraying was started on the left of the patch. The rig was driven between the third and fourth rows

from the left, and the horse stopped about ten feet from the end of the row. The three rows on the left of the cart were then sprayed as far behind and in front of the cart as it was possible to reach with the hose, the man at the pump meanwhile keeping up a steady pressure. When that area had been thoroughly covered, the pumping was stopped, the cut-off turned, and the horse driven ahead another fifteen or twenty feet, when the process was repeated, pumping was stopped when ever the rig was being moved. In this way, great thoroughness was possible, and an eandeavor was constantly made to get under the leaves as far as possible, the two parts of the Vermorel nozzle being turned upward at an angle of forty five degrees for this reason. As the season advanced, and the vines began to spread over the ground between the rows, it was sometimes necessary to lay them aside before advancing with the horse and rig. Spraying three rows at once had the advantage of greater speed, and in necessitating a minimum number of trips through the patch, and therefore fewer vines injured by the wheels of the cart. On arriving at the end of the row, the cart was turned, and retraced its path in the same tracks, spraying the three rows on the other side. In this way, six rows were sprayed with but a single track of the cart. As mentioned before, only one half of each patch was sprayed, the other being left for a check.

Patch No. 1

This was located about three miles and a half south west of town, and was owned by Mr. N. Snyder. It was of one acre on rather light sandy soil, on a gentle slope from south to north, the rows running east and west. The pre-

vailing winds in this region being from the southwest, the south half of the patch , of nine rows, were sprayed with 75 gallons of Bordeaux on July 20th, for the first time. On this date, the plants were rather small, but appeared healthy and had just begun to bear. The weather was very hot and sultry , with practically no wind. The plants were planted in drilled rows.

On July 27th, the second and last spraying was made on this patch. During the week between sprayings, a heavy rain had relieved the drought, but washed most of the spray from the leaves. On this date, there was no appreciable difference to be noted between the sprayed and the unsprayed sides, as no disease was evident on either. The application of water to the plants under a scorching sun wilted them temporarily, but did not burn them to any extent. This feature, however, alarmed Mr. Snyder, who also declared that the yield was lower on the sprayed side, that the rows were too close together for effective work, and that the lime hurt the hands of the pickers. For these reasons, he decided to abandon the spraying.

On September 4th, a survey was made over all the patches, noting the prevalence of disease, and the effect of the spray A summary of the diseases , as well as weather table will be found later in the article . On this date, Patch No. 1 was found to be affected mostly with downy mildew, and to some extent with a more or less uncertain disease, described later as fusarium wilt. Aphis were also very bad, and had destroyed some plants. Even at that date, with only two sprayings at the beginning of the season six weeks before, the sprayed side was healthier then the other. The last picking

had been made on August 31st.

Patch No. 5.

This was on an adjoining farm to Patch No. 1,and was of one acre, owned by Mr. G. A. Kleinsmith. It was on sandy loam soil, on level ground, the rows running east and west. The first spraying was made on July 20th, with 75 gallons, the plants being at that time of good size and just coming into bearing. They were planted in hills, and were slightly too thick. The southern half of ten rows was sprayed ? Some of the vines appeared at that time to be affected with a peculiar wilt, which was probably due to the attacks of the larvae of the striped cucumber beetle, the gnawings of which could be plainly seen on the main root of the plant, just below the surface of the ground. This caused the death of a few plants, but did not appreciably injure the value of the patch.

On July 27th, the second and last spraying was done, requiring this time about 125 gallons for the half acre. The plants were growing fast, and none were as yet affected by disease. Although Mr. Kliensmith was more progressive than his neighbors, and believed in spraying, he received such poor returns from his patch that he decided to not continue the work, and the spraying was discontinued.

On September 4th, it was noted that the patch was affected with downy mildew principally , and also to some extent by fusarium wilt. Aphis had killed many plants. An appreciable difference was to noted between the two sides, much in favor of the sprayed, even after long neglect. The last picking was made on August 14th.

Patch No. 4.

This patch, also of one acre, was about one and one half miles further to the southwest, and was owned by Mr. G. H. Towle. The latter had owned a peach orchard in Michigan, and was therefore acquainted with, and in favor of spraying. The patch was on rather heavy, level soil,. the rows running north and south. They were planted eight feet apart , in hills, so that there were comparatively few plants on the ground. The first spraying of 75 gallons was made on July 23rd, Most of the plants were healthy, but not very vigorous except in scattered portions of the patch. The western half of the twelve rows were sprayed.

The second spraying was made on July 29th, The plants at this time showed some discolored leaves, which I believe to have been caused by excessive fertilization, Mr . Towle being an amateur at cucumber growing, and admitting an over fertilization. No disease was apparent on any of the plants. The plants were growing fast, and required 100 gallons to cover them. They had not yielded heavily as yet.

On August 4th the third spraying was made with 125 gallons . The sprayed side at this time looked much better than the unsprayed portion, fusarium wilt having started in the patch; the unsprayed plants were suffering badly from this disease, and a few were attacked on the sprayed side, but they were comparatively few.

The fouth spraying was made on August 12th, with 90 gallons. The patch at this time was in bad shape, due primarily to the attacks of aphis, which were equally severe on both the sprayed and unsprayed portions, having completely killed some plants. Fungous diseases, on the other hand , were completely under control on the sprayed

vines, although they were not bearing well. The unsprayed plants were almost dead from the combined attacks of aphis and fusarium wilt.

The fifth spraying was made on August 18th. The returns up until that time had been very poor, as but $12.00 had been taken off of Mr. Towle's patch, while an adjoining patch of one acre, on practically the same sort of ground had yielded $29.00 during the same period, although all of the plants on this latter acerage were badly diseased with fusarium , and suffering from aphis attacks. The plants on the sprayed side were almost totally free from fungous attacks, but many of them had been killed by aphis. Neither side yielded more than 30 pounds of first grade pickles in three days.

On August 25th the last spraying was made, using this time , for testing purposes, a "Standard" outfit , a knapsack sprayer, using about thirty gallons on the few plants which had not been killed by aphis, but which were still free from fungous disease of all kinds. The unsprayed vines were very badly diseased. The "Standard " outfit proved little better than a toy, and could never be successfully used for spraying cucumbers on a commercial scale at least without an improvement in the nozzle used. With the one furnished, it was found impossible to get under the leaves without excessive stooping . With a longer nozzle this might have been accomplished. It threw a fairly fine spray, but required tem minutes to pump out four gallons, its capacity , and to this is added the difficulty of frequent filling, which is especially objectionable if the patch ia at a considerable distance from the water supply. It has no compressed air supply, is difficult to operate, and heavy

to carry around.

On September 4th, it was noted that the entire patch had been killed by aphis , together with fusarium wilt on the unsprayed portion. A very little downy mildew was present at that time on the few remaining plants. Up until their extinction by aphis, the sprayed plants remained free from fungus.

Patch No. 5.

This was one of the largest patches, being of one and one half acres, about one half mile south of Patch No. 4. It was owned by Mr. P. F. Mc Creary, who rendered valuable aid throughout the summer. The rows had been drilled, and ran north and south over a hill of almost pure yellow blown sand. When the first spraying was made, on July 24th, with 100 gallons, the plants were vigorous, fairly thick and uniform. The western half of nine rows were sprayed. The eastern half seemed to be suffering quite severely from drought.

The second spraying was made on July 29th, at which time 125 gallons were required. The plants showed the first effects of the attack of the fusarium wilt, which was equally prevalent on both sides of the patch.

On August 4th and 5th, the third spray treatment was given, again using 125 gallons. At this time, it was found that the patch was suffering badly from drought, many of the leaves being turned down like closed umbrellas, making it difficult to reach the lower surfaces with the spray. The sprayed side was much healthier than the other, which was suffering quite severely from the fusarium wilt, which the vines on the sprayed portion were comparatively free from.

The fourth treatment was given on August 12th and 13th,

with 115 gallons. A great difference was noticeable between the two sides, much in favor of the sprayed portion, the plants of which are healthy and green,while the rest are yellow and sickly. Neither side, however, was bearing well.

On August 18th and 19th, when the fifth spraying was done with 115 gallons, it was noted that the first attacks of the lice or aphis had commenced, while the fungous conditions were about the same as those of the previous week. The entire patch yielded, but two pecks of first grade pickles in a day, which was very remarkable considering the good appearance of the vines on the sprayed side.

The sixth spraying was made on August 25th and 26th, Only 85 gallons were required, due to the fact that many of the vines were being killed by the aphis, but were free from fungous attacks, while the unsprayed plants were without exception yellow and diseased with fusarium wilt, and a very little bacterial spot.

The seventh and last spraying was done on September 1st with 70 gallons. The patch at this time was bearing as well as at any time during the season, while most of the other growers had stopped picking. The plants on the unsprayed side showed for the first time a few leaves bearing the effects of downy mildew. In an effort to control the aphis , 50 pounds of tobacco dust was applied to about one quarter of the patch , including those sprayed rows most affected by their ravages. They seemed to be more numerous on the sprayed plants than on the unsprayed , probably because the former were healthier, greener, and more succulent. The dust was strewn lightly over the plants. On being examined the next day, it was found that practically every insect had been destroyed by the

nicotine on those plants to which it had been applied. If such a remedy had been tried on other patches, the results would have shown much better, as without exception , the plants on the sprayed side were destroyed by aphis and not by fungus.

On the final inspection of September 4th, it was found that the plants on the unsprayed side had been killed mostly by the attacks of fusarium wilt and bacterial spot, with some small evidences of downy mildew. Some effects of white pickle were also seen here , both on the sprayed and the unsprayed sides, although the other disease had been confined to the unsprayed half. The sprayed half at that time was producing as well as at any time during the season, while the untreated side had stopped a week previously.

Patch No. 6.

This was a small patch of one half acre , between patches 4 and 5. It was owned by Mr. W. S. Hartman, and was planted on the same ground on which a patch a year previously had been destroyed by a disease, probably from his description, caused by the white pickle. The patch was on sandy soil, on a slight slope from east to west, the rows running in the same direction. The first spraying, with 4$_{0}$ gallons, was made on July 23rd, using the southern half of four rows. The plants were at that time healthy , but suffering from lack of water.

Forty gallons more were required at the second spraying on July 30th. The plants which had been sprayed looked far healthier than the others, although no specific diseases, with the possible exception of the beginning of the fusarium wilt,

could be noted on any of them.

The third spraying was made on August 4th, using 50 gallons. The sprayed side at this time looked far better than the other, and Mr. Hartman reported it to be yielding better. The unsprayed side by this time was suffering badly from the attacks of fusarium wilt, this disease having actual ly killed some at one end, and the entire portion was very badly diseased. Some plants were also suffering from this in the sprayed portion, but these were comparatively few. The fact that it was planted on the same ground as a similarily affected patch of the previcus season, made it especially hard to combat. There were also some slight indications of the appearance of white pickle on both sides.

On August 12th the fourth spraying was made, with 35 gallons. As a whole, the plants on the sprayed side were in good shape, as far as fungous disease went, but the plants on both sides were infected with aphis, which were not, however, as prevalent in this patch as in others in the vicinity. The plants on the unsprayed side were nearly dead, and those on the other side, while apparently healthy were bearing very poorly, and yielding some white pickle, although the vines themselves showed very little evidence of disease.

Forty gallons of spray were used on this patch on August 18th. At this time, probably induced by recent rains, the entire patch looked better, the plants on both sides having put on new runners, which had not as yet had a chance to blossom.

The final treatment was given on August 25th, using 50 gallons. The improvement noted the week previous proved to be but the final effort of the dying plants. The aphis

had increased in severity, and had nearly killed all the vines on both sides, although those on the sprayed side looked to be free from disease, although still yielding white pickles to some extent.

On September 4th, it was noted that the plants were not completely dead , but nearly all of them, including a good percentage of those on the sprayed side, were affected with white pickle. While the foliage of those plants looked to be healthy, the plants produced deformed fruits nearly all season. A little anthracnose was also observed at this time and aphis were prevalent. Last picking was made on August 25 .

Patch No. 7.

This patch was located on the outskirts of the town, and was planted and managed by an amateur, who was not very enthusiastic about spraying from the beginning, and became less so after the first application. It was owned by Mr. William White, and was planted on light, sandy soil on top of a slight rise, sloping somewhat from east to west, grading into darker and heavier soil at the base of the slope . When the first and only spraying was made, on July 21st, the plants were vigorous only in spots, some of them seeming to suffer from drought. A little less than half the patch was treated with 50 gallons. The rows, running east and west, were drilled. The southern six rows or a little less than half the patch of one half acre were sprayed.

On September 4th, it was found that the plants at that time were affected mostly with fusarium wilt and bacterial leaf spot. Some downy mildew and aphis were also present. The plants were not entirely dead, and no difference could be noted between the sprayed and unsprayed sides, although

when this patch was visited on August 11th, considerable difference in the health of the two sides was noticed, in favor of the sprayed portion. The last picking was made on August 15th.

Patch No. 8.

This patch was also sprayed but once, Mr. Frank Sebell, the owner, becoming alarmed when he found that the plants had temporarily wilted after the first application, and fearing that they would be permanently injured. The water supply also for this patch was almost a mile away , necessitating a long haul in the spray cart, and making it very inconvenient to reach it in a short time. The patch was of one acre in extent , laid out in the middle of a patch of woods, which had been cleared only two years before, and planted to corn once. Many of the original stumps still remained. High trees were on the south and west, cutting off much of the wind, and open fields surrounded the other two sides. The rows ran east and west, and the northern half of eight rows was sprayed on July 31st. The soil was a light sandy loam, and the plants were all very think and vigorous. In fact , they showed to a marked degree the abscence of thinning, and at that early date were matted in the rows, requiring 100 gallons to the half acre. No diseases of any nature were evidence.

On the final inspection trip, September 4th, it was found that this patch had been badly infested with downy mildew and to some extent with fusarium wilt. As these plants had been planted on new ground, never before planted to cucumbers, and the patch was at least a mile away from any neighboring patches, the fact of this bad disease inoculation is all the

more remarkable. The vines in the southern end were particularly bad in this respect, many of them having been killed. Those in the northern end, especially those on the sprayed were quite free from disease, although the effect of the spray was not very noticeable. A very little anthracnose and bacterial spot were also found at this time , and aphis were present in considerable numbers. The last picking had been made on August 17th.

Patch No. 9.

This was one of the most successful patches with which I had to deal, and many good results came from the work upon it. It was almost in the center of the town, on rented land, and grown by an amateur. The owner, Mr. Frank Cullison, was very much interested in the spraying work, and rendered much help during the summer. The first spraying was made on July 22nd, using 75 gallons. The patch was of one and one half acres, on rather heavy soil. At this time, the plants were not as far along as those grown on lighter soil, but before the end of the season they had outstripped any of the patches in the vicinity. The plants were small , but healthy, and well distributed, without overcrowding. The best plants were about in the center of the patch, shading off at both ends to smaller plants, where the drainage was somewhat poor. The rows ran east andwest, and the northern half of eleven rows was sprayed.

The second spraying was made on July 31st, using this time 125 gallons, due to the increased size of the plants. The patch was doing very well, all of the smaller plants at the ends having enlarged greatly and the

larger ,plants having become matted together. No appreciable difference as to disease on the two sides could be noticed.

On August 5 - 6th, the third spraying was made, with 140 gallons. The sprayed side on these dates looked far improved over the other, fusarium wilt having set in to a considerable extent. As it was on heavier land, it was with standing the drought better than some neighboring patches. Mr. Cullison also reported that the sprayed side was yielding better than the other.

One hundred and sixty gallons were used on the fourth spraying, made on August 14th. The plants by this time were of large size, and looked very well. Those on the unsprayed side were badly affected with fusarium wilt, while the sprayed vines were green and healthy.

The fifth spraying was made on August 20th, with 165 gallons. Following the rain of one or two days before, the plants were covered with blossoms, and gave evidences of producing well in the next few days. On that day, the yield from the sprayed and unsprayed side was weighed. It was found that 30 pounds of first grade pickles had been gathered from the sprayed half, and 17 pounds from the unsprayed half. The following day, the pickles on two representative rows of the two sides, less than one inch in length , were counted to ascertain something of the relative yields of the two sides. In the two rows of the sprayed side there were found to be 928 small pickles, while in the two rows of the same length on the unsprayed side were found 768 small pickles. On an average , this should give approximately 5104 pickles on the entire sprayed side, and 4224 on the unsprayed side, or a gain of about twenty percent. On this date, the sprayed

side looked very well, but was beginning to be infected with lice. On this date also, the first indication of downy mildew put in its appearance on the unsprayed side.

The sixth spraying was made on August 26 - 27th. On these days, two successive sprayings were made, the first with Bordeaux at normal strength, and the second with nicotine, or Black "40" , diluted 1-800, and put on with the regular spray rig. The vines on the sprayed side only were treated with nicotine, in an endeavor to control the lice , which were becoming more numerous , and had already killed some plants. In order to make the work more effective, the individual vines were carefully turned over by hand, sprayed on the under surfaces, and turned back again. Downy mildew at this time was spreading rather slowly over the unsprayed side, the plants of the other showing no indication that they had been attacked by the disease. About 140 gallons of Bordeaux were used at this time. Immediately upon the completion of this spray , 150 gallons of nicotine solution were applied. Upom being examined the foloowing day, the plants were found to be practically free from aphis, the latter having been almost exterminated, and falling from the leaves like dust when the latter were shaken. It is unfortunate that either this spray or tobacco dust had not been applied to this and other patches at an earlier date. If had been done, there is every probability that the vines would have continued to bear much longer than they did.

On September 2nd, the last spraying was made, with 100 gallons. The patch was practically done bearing, the entire unsprayed half being killed by downy mildew. The sprayed side was still green and healthy. Some few leaves on that side were beginning to be affected with bacterial

spot, but none could be found which showed signs of mildew, even on that row which was adjacent to the unsprayed half , killed by the disease. Aphis had reappeared in small numbers. A portion of this spraying was done with the "Perfection" sprayer. This is a air tight tank, holding three gallons, fitted with three feet of hose, and a single Vermore 1 nozzle, with cut-off. The handle, resembling that of a bicycle pump, is used to compress the air in the tank, which forces the liquid out through the nozzle. The spray continues for a considerable time after the pumping has ceased, making it unnecessary for the operator to pump continuously. This apparatus worked fairly well, but gives hardly enough pressure and it is very difficult to get under the leaves with it. It would probably work well with nicotine, after the plants had been turned over, and only scattering ones needed to be sprayed.

The final inspection, on September 4th, showed the following: The unsprayed side had been entirely killed by downy mildew. Although other diseases had been present earlier in the season, this had crowded them out in two weeks after its first appearance, on August 30th. With the exception of one or two plants on the sprayed row next to the unsprayed side, the disease could not be found on that side. A few leaves were affected with the bacterial spot. Aphis had been very bad on the sprayed side, more so than on the other, but had been thoroughly controlled by nicotine spray, not however, without killing many plants, and spoiling to some extent the value of the experiment, as far as the farmers in the vicinity were concerned, who were as unfamilar with a fungical spray and a insecticide spray to be unable to distinguish between them .

Patch No 10.

This patch was only a few rods from patch No 9, but under radically diffenent management, and on totally different soil. Mr. Jacob Francis, its owner, was interested in spraying at the outset, but his enthusiasm rapidly waned after the first application, although he admitted that the sprayed side looked better than the unsprayed, and actually yielded better. He decided after the second spraying, to discontinue it. His patch was of three quarters of an acre, on light sandy soil. The plants were in hills, three feet apart in the row, and the rows six feet apart. The rows ran east and west, and as the patch was triangular, it was difficult to judge its half. At the first spraying, on July 22nd, the northern seven and one half rows were sprayed with 35 gallons. The plants at the western end had been reset, and were consequently small, but healthy. Most of the plants were strong and vigorous.

On July 31st, the time of the last spraying, about 50 gallons to the quarter acre were applied. The unsprayed side particularly was suffering quite badly from the attack of fungus fusarium wilt, which was also present to a small extent on the sprayed side, which, however, looks much the better of the two, and was reported to be yeilding better.

On September 4th, it was found the patch had been plowed under, but during the season, the plants had been attacked by fusarium wilt, and later had been killed by downy mildew. Up until the time of its removal, the sprayed side was by far the better. The last picking was made on August 21st.

Patch No. 11.

Mr. Fred Buck was the owner of this patch, and he also became alarmed at the wilting of the plants after the first spraying, refusing to carry the experiment further. His patch was of one and one half acres, on heavy ground on the bank a river, about a quarter of a mile from patch 7. The rows were short, and raneast and west. The land had been well fertilized, and the plants were growing well, when the first spraying was done on July 21 - 22, although they seemed to be suffering somewhat from drought, even on that heavy soil. They were in drilled rows, and needed thinning badly. The southern half of twenty-three rows were sprayed with 75 gallons.

On September 4th, when this patch was examined , it was found that it had been totally killed by anthracnose. There were also some few evidences of bacterial spot, fusarium wilt , and white pickle, although the first mentioned disease was by far the most serious. Aphis were also fairly abundant, and there was no appreciable difference between the unsprayed and sprayed portions. The picking had been finished August 17th.

Patch No. 12.

Mr. Fairbanks, who owned this patch,, was probably the best pickle grower with whom I had to deal. Although his plants had not been set out until July 4th, almost a month later than the other patches, they were almost as large as any of the neighboring patches, and were very vigorous. The first spraying was put on July 25th, about one o'clock in the afternoon. A hard rain had fallen the night previous,

it had been cloudy all the morning, and the sun came out very bright and hot at the time the spray was applied. The ground and plants were wet, and upon examining them a week later it was found that the spray had burned the foliage to some extent. This was the only case of burning which I noticed during the season, and was undoubtedly caused by the peculiar climatic conditionswhich prevailed at the time. This fact, however, prejucided Mr. Fairbanks against spraying, and it was discontinued. This patch was a few rods from Patch No. 11, on very good, rich loam soil, and the plants without exception were vigorous and healthy, in hills, the rows running north and south. The eastern half of five long rows was sprayed with 100 gallons. The patch was on land formerly planted to a vineyard, and the southern half of the five sprayed rows, together with the same half of the adjacent unsprayed rows, was planted the previous year to pickles which had been killed by "blight" probably downy mildew.

On August 26, upon examining this patch it was found that it was at that time practically dead from aphis and downy mildew the latter having started six days before, and spread with almost inconceivable rapidity, converting a patch which was be aring splendidly into a mass of dead vines. On September 4th these observations were confirmed, and this seemed to be the only fungus disease present, with the possible exception of a very little white pickle. No difference was noticeable between the sprayed and unsprayed portions. The last picking had been made on August 24th.

patch. No. 13.

Permission to spray this patch was obtained somewhat later than the foregoing, and it was sprayed but once, the owner, Mr. Armington, receiving such poor returns from it, that he decided to abandon all work upon it. It was of one half acre, on sandy loam soil on the top of a hill. The patch was triangular in shape so it was difficult to judge at the half. The plants were in hills, about eight feet apart one way, and five the other. They appeared quite vigorous at the time of the first and last spraying, on July 28th, although there were some slight possiblilities of the start of fusarium wilt. The eastern half of the patch was sprayed with 35 gallons.

On September 4th, it was found that the patch had practically been destroyed by aphis, only a few plants remaining at that time. The worst fungus disease had been the fusarium wilt, with downy mildew and anthracnose also present in small amounts. There was no appreciable difference between the two sides. The last picking had been made on August 24th.

Patch No. 14

This patch, together with the next three, was obtained about two weeks later than the first twelve, in order to test the advisability of beginning spraying later in the season, and to find whether disease, already started in a patch, could be successfully combated. This patch was about half a mile west of town, a short distance from patches 9 and 10, owned by Mr. Huffner. It was of one acre , only

one quarter of which, however, was sprayed, for the first and only time on August 6th. The patch was sprayed only once since disease had already overtaking the plants to such as extent to make it impractical. The patch was on light soil, on a slope from south to north, the rows, with plants in hills , running in the same direction. The plants were poorly cared for, being choked with weeds, and allowed to run wild. Very severe indications of white pickle and fusarium wilt had already developed over the entire patch at this time.

On September 4th it was noted that the plants had been damaged mostly by fusarium wilt and white pickle , together with a very little downy mildew. There was no distinguishable difference between the two sides. No lice were found on this patch.

Patch No. 15.

This was another of those which were started late, but was probably the best of that group. It was owned by Mr. Clinger, and was located about a quarter mile from Patch No. 14. It was of one acre in extent, on a light soil, situated on a slight slope from south to north, the rows, with plants in hills running east and west. The southern quarter of the patch was sprayed for the first time on August 7th. The plants at that time were small, and were somewhat suffering from drought. In the extreme corner, on the sprayed side a few leaves were beginning to show the first indications of an attack from anthracnose. Owing to the fact that the water supply was very poor here, only a quarter of the patch of twelve rows were sprayed with 50 gallons.

The second spraying was made on August 14th, with 65 gallons. At this time the plants had increased a third in size, but it was noticed that the anthracnose, which began the previous weel, had increased on the affected plants and spread to new ones, even those which had been sprayed. A few plants on the unsprayed side were beginning to be affected with fusarium wilt, but none as yeat with anthracnose.

On August 20th, the third spraying was made, with 60 gallons. The plants were found to be covered with blossoms, and gave promise of bearing heavily within the next few days. The entire patch lookedfairly well, there being no increase in anthracnose , although the fusarium wilt was spreading slowly on the unsprayed side.

The last spraying was put on on August 31st, using 60 gallons. The plants all over the patch were found to be covered with anthracnose, which was almost as prevalent on the sprayed as on the unsprayed side, although the latter was slightly worse off in this respect. In addition, the plants on the unsprayed side were becoming badly infected with downy mildew, and between the two diseases, there appeared little chance that that side would survive. There was no downy mildew found on the sprayed portion.

At the final inspection on September 4th it was determined that the entire unsprayed side had been destroyed by anthracnose and mildew, principally the former. The plants on the sprayed side were also badly affected with anthracnose, but showed no signs of mildew. Lice had also appeared on both sides to add to the destruction . The patch had gone down quickly when disease started, the last picking being made on Aug. 31st

Patch No. 16.

This patch was located on the opposite side of the town to Patches 9, 10, 14, and 15, and was not within a mile of any other. It was owned by Mr. Knappen, and was of one and one half acres . The water supply being poor here also, only a quarter of the patch was sprayed. It was on moderately heavy land, almost black, and seemed to hold the moisture fairly well, the sprayed end being the better in that respect . The rows ran north and south, fourteen rows on the east end being sprayed with 100 gallons for the first time on August 8th, There was no evidence of disease present at this time, and the plants appeared fairly healthy. The second spray was made on August 15th, with 100 gallons. The patch looked fairly well on the sprayed end, but very poorly on the other, although a good crop was promised for the next few days as a result of a recent rain. Fusarium wilt had started on the unsprayed portion and was spreading rapidly, although none had appeared on the sprayed portion. Despite the application of nicotine solution with the "Perfection" sprayer described above, about two weeks before by the owner, aphis were gaining a dangerous foothold, and had already killed some plants on both sides.

On August 21st the last spraying was made with 80 gallons. The plants on the sprayed side looked quite promising, and were free from fungous disease, but the vines on the other end were about almost dead from fusarium wilt. Aphis were destroying the plants on both sides, which was the occasion for the abandonment of the patch.

Upon inspecting it on September 4th, it was found that downy mildew had obtained a foothold on the unsprayed side,

and had completed its destruction. The sprayed end, on the other end, was almost totally free from fungus attacks, although most of the plants there had succumbed to aphis attacks. The last picking had been made on August 18th.

Patch No. 17.

This was located between Patches 9 and 15, and was owned by Mr. Mann. It was located on moderately heavy soil, which had been well fertilized. The plants were in drilled rows running east and west. The first spraying was made with 85 gallons for the first time on August 6th, treating the south half of 21 rows. The plants were large, but were badly affected with fusarium wilt, which was present in great abundance throughout the patch. No other disease was apparent on that date.

The second and last spraying was made on August 14th, with 85 gallons. There was no appreciable improvement in the diseased plants , and as they were not growing with sufficient rapidity to send out new runners, there was no opportunity to judge the effectiveness of control of the spread of the disease to new leaves. As the aphis were appearing here also, it was decided to abandon this patch. Mr. Mann reported that the yield had been reduced on the sprayed portion.

On September 4th, it was found that the patch had been plowed under. Up until the time of its removal, it was noticed that the entire patch was badly infested with fusarium wilt, bacterial spot, and white pickle, the last being probably the most abundant. While there may have been some slight difference of appearance in favor of the sprayed side, there certainly was none in the amount of yield, which on the other hand, was in the opposite direction. The last picking was on August 10th.

A summary of the conditions described above would probably yield the following main cardinal points.

1. patches sprayed all season show complete control of all diseases, with the possible exception of white pickle, patches No. 9, 4, 5, 6.
2. patches left unsprayed until the diseases had gained a foothold showed little or no control, (14, 15, 17)
3. Patches where no spraying had been done at the beginning of the season , but which had been sprayed before disease commenced, showed complete control. (16)
4. patches sprayed once at the beginning of the season,and then dropped showed no control (7, 8, 11, 12, 13)
5. Patches sprayed twice at the beginning of the season and then abandoned, showed partial control, (1, 3, 10)

This may be summarized in the following table.

No.	Times Spray	Begun	Disease already start.	Control	Disease End Season	Culture Methods	Soil	Report Yield.
1.	2	7/20	No	Partial	DM, FW	Good	Light	Decrease
2.		Never						
3.	2	7/20	No	Partial	DM, FW	Good	Light	Decrease
4.	6	7/23	No	Complete	FW	Fair	Heavy	No Diff.
5.	7	7/24	No	Complete	FW, BS, DM, WP	Good	Light	Increase
6.	6	7/23	No	Partial	WP, A	Fair	Light	Increase
7.	1	7/21	No	None	FW, BS, DM	Fair	Light	Decrease
8.	1	7/21	No	None	DM, A, BS	Good	Light	Decrease
9.	7	7/22	No	Complete	DM, BS, FW	Good	Heavy	Increase
10.	2	7/22	No	Partial	FW, DM	Fair	Light	Increase
11.	1	7/21-22	No	None	A, BS, FW, WP	Fair	Heavy	Decrease
12.	1	7/25	No	None	DM, WP.	Excellent	Heavy	No Diff.
13.	1	7/28	No	None	FW, A, DM	Fair	Light	No Diff.
14.	1	8/6	Yes	None	FW, WP, DM	Fair	Light	Decrease
15.	4	8/7	Yes	Partial	A, DM, FW	Good	Light	No Diff.
16.	5	8/8	No	Complete	DM, FW	Good	Light	Increase
17.	2	8/6	Yes	None	DM, WP, BS, FW	Fair	Light	Decrease

In the above table, the diseases which were found on the patches at the final inspection , either all over the patch in case of no control, or on the unsprayed side in the case of control or partial control, are designated by initials. Fusarium wilt - "FW", Downy Mildew - "DM", Bacterial Spot - "BS", White Pickle - "WP", and Anthracnose by "A". The control refers to the control of fungus and bacterial disease only, and has nothing to do with aphis , which, however, were proved to be easily controllable by either spraying with nicotine, or treating with tobacco dust.

- Other Inspection Trips. -

That the diseases described below were not confined to the vicinity of Plymouth, but were scattered more or less throughout the surrounding county at least was proved by two inspection trips which the writer made to two neighboring towns. On July 26th a trip was made to Walkerton, about twelve miles north of Plymouth, where a patch was examined which was already affected to a serious degree with fusarium wilt, in all parts of the patch. This trouble was found to be identical with that later found on the experimental patches. Later in the season, on September 5th a trip was taken to patches about twenty miles to the south of Plymouth, where it was found that the great majority of the vines in that locality had been destroyed by downy mildew.

- Diseases and their Control. -

Some difficulty was encountered throughout the season in a rapid identification of the diseases encountered, due in a great degree to the lack of any appartus , with the exception of a hand magnifying lens, which would aid in determining their nature. However, by this aid, and by sending samples to var-

ious experiment stations for identifications, the five principal diseases encountered were quite accurately determined and in the case of three of them at least there can be no doubt that they were the diseases described below.

- Downy Mildew. -

Probably the one which caused the most damage was the downy mildew, Plasmopara cubensis. This first appeared on August 30th, following the wet weather of several days previous, which may be observed by reference to the weather and rain fall charts at the end of this article. There followed cool weather for the next three or four days, and it spread moderately slowly, but the hot wave of August 24th sent it ahead again, and it soon destroyed those patches which it attacked. The disease first manifested itself by mottling of the leaves, green and yellow, the latter appearing in confluent, indistinctly angular spots, more noticeable on the upper sides of the leaves than on the lower. Later, distinctly angular dead spots appear in the center of the angular mottlings, and in most cases these spots are covered on the under sides of the leaves by a fuzz-like growth of conidiaphores and spores, which are present in such numbers that they could be distinguished with the hand lens. This disease was so manifestly downy mildew that specimens were sent only to Michigan Station, and to Mr. C. S. Carsner, who was working on similar diseases in Wisconsin, both of whom replied in the affirmative. Further evidences were gained by myself, by examining scrapings from the under sides of affected leaves under a compound microscope, at which time typical mildew conidiaphores were found in abundance. The control of this disease was perfect throughout the season,

hardly a leaf on the entire sprayed portions of the patches being affected with the disease, though many of them were but a few feet from plants which were dying from the disease.

- Anthracnose. -

The second disease of importance was anthracnose, Colletotrichum lagenarium, which was not as prevalent as downy mildew, but proved harder to combat, and was not controlled so successfully. This was first noticed about August 5th, and spread over the entire patch in the course of the next three weeks, spreading almost as rapidly over the sprayed, as over the unsprayed area. The disease showed itself in round, dead spots, on the leaves, from one eighth to one half an inch in diameter. As these grow they finally cause the death of the leaf, becoming confluent. No injury to the stems or fruits was found. The Stations at Geneva and Cornell reported this disease to be anthracnose, as did also Mr. Doolittle, in Michigan, and Mr. Carsner in Wisconsin, both of whom were sent samples of the disease. The Indiana Station reported it as Macrosporium cucumerinum. Although the writer had no facilities for determining the organism himself, the disease was undoubtedly as stated.

- White Pickle. -

The third disease of which there is no doubt as to its nature was white pickle, the cause of which is as yet undetermined. This disease was characterized chiefly by its deformed and whitened fruits, which gives it its name. The pickles were usually covered with large, irregular warts usually green in color, with the remainder of the fruit turning white, hard and sometimes more or less glossy. The plants which

produced them either remained greatly stunted with thick, small, green, leaves or grew to a normal size, the leaves turning first yellow and later brown and dead. For this latter reason, it may be possible that there is some relation between this disease and the so-called fusarium wilt, which will be described later. It was noticed that white pickles came from vines affected with the fusarium wilt, although on the other hand such plants also produced normal fruits. This relationship was suggested by Dr. Donald Reddick , of Cornell Station, although it is as yet still a very mooted question.

The white pickle disease was the hardest to control of any of those encountered, and indeed it may almost be stated that Bordeaux mixture, at least at the strength employed , will not bring about control of this disease.

- Bacterial Spot -

This was the least serious disease encountered, and its exact nature could not be determined, as the various sources to which specimens were sent varied greatly in the diagnosis Geneva reported it to be caused by the striped beetle, Doolittle was unable to ascertain its cause, Cornell called it a Bacterial Leaf Spot of unknown cause, Michigan acquiesced in this opinion, as did Carsner, While Indiana reported it to be the same as downy mildew. In my own opinion , I believe it to be similar to the angular leaf spot of cottom, Pseudomonas malvacearum, if not the identical disease. It occured as distinctly angular dead spots on the leaves , without yellowing of the surrounding tissues, wherein it differed from those caused by downy mildew, which were invariably in the center of yellowish areas. Another difference between the two lies in the fact that the spots caused by the

bacterial disease are equally apparent on both sides of the leaf, while those of downy mildew are more conspicious on the under surface. This disease, although caused by bacteria was fairly well controlled by spraying, although its damage was very slight.

- Fusarium Wilt. -

This disease, which had been called by this name throughout this article , for want of a better one, was by far the most prevalent, although not the not the most serious with which I had to deal. It started as early as the twentyieth of July, and persisted throughout the summer, being still present when the work was stopped in September. It began by a generally yellowing of the foliage of the plants, which remained as stiff as usual, and did not show any of the characteristic wilting of bacterial wilt. Neither did the stems when examined at various experiment stations, show the presence of bacterial wilt organisms. As the disease progressed, the leaves began to show dead areas about their margins, which spread very slowly until the entire leaf had been killed. Finally all the leaves of the plant were killed but so slow was its spread, that a very small percentage of vines were killed by this disease all season, although nearly every plant in nearly every patch was affected. It seemed to flourish on all sorts of soil,under all sorts of cultural conditions, and without regard to weather conditions.

Although the disease did not kill the vines, it materially decreased the yields. As has been mentioned above there may be some relation between this disease and the white pickle disease, as some vines affected by symptons characteristic of the fusarium wilt grew white pickles. On

the other hand , similarly affected plants produced perfectly normal pickles, though in reduced quantities, throughout the growing season. Spraying was almost entirely successful in preventing this disease. That is, the plants sprayed looked far healthier and greener than those left unsprayed, although the yield was not materially increased. The latter condition may have been due either to spraying in bloom , and thus injuring the blossoms , or to the action of the disease.

Plants affected with this disease were sent to various experiment stations for identification, and the replies received varied greatly as to the diagnosis. Geneva reported that that its determination was not certain , but that it looked like "BLIGHT" . Mr. Doolittle replied that he was unable to ascertain its nature. Cornell reported that it was a wilt disease of fungous origin, but that it was not certain just what fungus it was, although it appeared to be some species of fusarium , from which the name in this article was taken. Michigan reported it to be anthracnose, which it most certainly was not. Connecticutt reported it to a fungus disease of some unknown species in the trachery tissues. Mr. Garsner also reported it to be a fungous disease of the tracheary system.

From these evidences, it appears rather definitely to be fungus and of the tracheary tissues. Since it was controlled so effectually by spraying, it must be some disease which was disseminated by spores. With a view of determining more of its exact nature , correspondence was taken up with Doctor Reddick of the Cornell Station. Plants affected with this disease were dug up and stripped of their leaves, and forwarded to him for examination, with the stems, fruits, and root intact. These fruits appeared to be affected with the

white pickle disease, and Doctor Reddick forwarded them to Professor Jagger of Rochester University, who was at that time making investigations concerning the white pickle disease. Doctor Reddick kept the remainder of the plants for the purpose of making inoculation experiments, and if possible of determining the nature of the trouble.

In early correspondence with him, he stated that in his opinion, the disease did not penetrate from the outside, and that the apparent success with spraying was not due to a checking of the disease, but to the checking of transpiration of the plant, thus keeping the leaves green. This view seems to be borne out by the fact that the sprayed plants, though appearing healty , bore no better than the unsprayed plants, which appeared diseased. As many of the species of Fusarium are saprophytic, much work was necessary to determine whether the Fusarium actually found in the tissues of the plants both at the Cornell and the Connecticut stations, was there as a parasite.

Six months after this correspondence was carried on, a letter was addressed to Doctor Reddick, requesting any further results which he had gained in connection with working with the disease. At this time, he seems to have come to the conclusion that this disease and the white pickle disease were one and the same thing, as he says," I regret to say that I am as yet unable to state definitely whether a species of Fusarium is responsible for the white pickle diseae or not. Some of the strains of Fusarium taken from the vascular bundles of affected plants are capable of producing a wilt of cuomber seedlings .... Professor Jaggeris of the opinion that the trouble is not of fungous origin

although he admits that he had not exhausted the possibilities along this line.

It is necessary to leave this disease in this present unsettled state. There seems to be nothing definite that can be said concerning it, except that there is apparent control with bordeaux spraying, and that it is spread very slowly but surely. When the causesof white pickle are definitely settled, the cause of this so-called fusarium wilt may also be found, and they will possibly be the same organism.

- Costs. -

These experiments were undertaken by the Heinz Company primarily to demonstrate to the farmers a practical and cheap method to fight the diseases of their pickles which were so decreasing their yields. The cost of the methods employed would therefore be a prime requisite of the value of the experiment.

The greater part of the writer's time was taken up in driving from patch to patch, and in pumping the water to prepare the spray. Only a small percentage was utilized in actually mixing and applying the spray. On the average , it may be stated that to fill the fifty gallon spray outfit, and to spray out that quantity , will require one hour with the water supply relatively near to the patch. About two hundred gallons to the acre were required for the average patch which would necessitate the filling of the apparatus four times to the acre. Taken all in all, spraying with the outfit used in these experiments, would require the services of two men and a horse for a half day of five hours, per acre . Under very favorable circumstances, perhaps an acre and a half may be covered in this time. Figuring the wages of a man at two dollars per day, with one dollar per day for the horse, it would cost$3.50 per acre for labor, for each application. In a normal season, eight such applications would probably be necessary , which would figure up to $20.00 for labor. For 200 gallons of 3-6-50 Bordeaux, with copper sulphate at six cents per pound, and lime at about a half cent, the cost of the materials would come to $0.84. For eight applications, the materials would come to $6.72 per acre, or a total cost of $26.72 per acre per season for labor and materials.

An outfit such as was used in listed at $30.00 complete. However, the pump costs but eight dollars, the axles about a dollar and a half, and the hose and rod about two dollars and seventy-five cents. Any farmer could purchase these accessories and mount them on a barrel and buggy or cultivator wheels, and have a complete outfit, which would work as well as a commercial one, for a cost of not over fifteen dollars. The individual patches are usually of small size, and close together. As spraying need only be done once a week, and as it takes but a day to spray two acres, as many as five farmers could combine in buying an outfit, which could be used in spraying their several patches for many years. Under this plan, the expense to each would be almost negligible, and the interest on the investment practically nothing. Under this plan therefore, it may be safely assumed that spraying can be done with high priced labor for approximately twenty-five dollars per season per acre. In many instances, this figure could be cut in half, as four fifths of it is for labor, which could be just as well done by boys on the farm, with only a third the earning capacity as men.

In a good growing season, therefore, when yields of from one hundred to one hundred and fifty dollars per acre can be expected if the crop is protected from disease, an expenditure from fifteen to twenty-five dollars in this insurance is certainly justifiable.

- Recommendations. -

Although results were quite satisfactory conducted under conditions described above, too much is left to the individual grower to make it extremely valuable. Such experiments should be carried out on an experiment plot, planted,

grown , and managed by the person conducting the experiment. In this way the plants could be grown under ideal conditions, experiments could be tried under a greater variety of conditions relative to different methods of applications, strengths and kinds of sprays to be employed, etc.
One of the greatest disadvantages encountered in conducting the experiments on private patches was the inability to measure the yields from the sprayed and the unsprayed portions. This could be accurately done in a company-owned patch. Much time would be saved in traveling from patch to patch, and in pumping water. The patch could be located near the salting station, or at any other central point, where the growers could see the benefits derived from the spraying when they passed. Another disadvantage of the private patch is the fact that spraying has to be done when it is convenient to the farmer, usually in the middle of the day, when the sun is hot, and the application of the spray tends to wilt or burn the foliage. In such a plot as was suggested, spraying could be done at the best times of the day. Spraying could be begun at any time of the season, and discontinued at any time, without relying on the prejudices of the individual growers.

The use of hand or other small sprayers is not recommended. As has been pointed out above , an efficient cart sprayer , such as was employed can be obtained very cheaply , and will last for years. The smaller sprayers require infinitely more time to operate, easily get out of order, and do not perform a first class job.

- Conclusions -

The cause of the rapid decrease in the yields of pickles in the vicinity of Plymouth was the prevalence of fungus, insect,

and bacterial disease.

All fungus diseases with the possible exception of "white pickle" can be controlled by spraying the vines, at intervals of a week or ten days through out the season , with 3-6-50 Bordeaux mixture.

Spraying for fungus does not need to begin until the diseases are found in the vicinity. That is, in some seasons it may not be necessary to spray at all. Spraying is the cheapest form of insurance.

The spray has to be on the plants by the time the disease hits the patch.

Spraying while in bloom probably decreases the yield provided that no disease is present. That is, healthy vines without spray produce better than healthy vines with spray.

Spraying in very hot weather is liable to wilt or burn the foliage.

Spraying with nicotine , or scattering tobacco dust on the plants will effectually kill aphis, and this is best done when the insects first appear.

In disease years, it pays to spray for fungus and insect pests.

The safe way is to spray every year.

- Spraying in Bloom. -

The Effect of Various Funicides on the Fertilization of the Cherry, peach, Plum, and Cumoumber .

INTRODUCTION.

During the summers experiments as narrated above it was observed that spraying apparently decreased the yield probably due to some injury to the blossom or its action as a repellent to the insect pollinators. Bordeaux may have caused an injury to the pollen, to the stigma or to both, and in order to ascertain if this supposition were correct experiments were conducted in the greenhouse on the various types of flowers which were available, using not only Bordeaux in several strengths but also some of the other more important fungicides.

We were fortunate in being able to secure as material for the work, a number of dwarf fruit trees in large pots which were brought into the greenhouse from out of doors and forced into bloom. On January 6th, the trees were given a general cleanup spray of strong lime sulphur for scale and then brought into the greenhouse. These trees were fertilized once with liquid sheep manure and were watered as needed. In all there were, two peaches, one cherry, and two plums which came into flower, and in addition there were two apples, two pears, and one apricot which failed to flower, having however borne heavily the previous year. Besides the fruit trees fifteen plants of cucumbers were raised from seed planted in pots January 5th.

The apparatus used was as follows:- A DeVilbiss atomizer No. 8, a small insect duster, brushes for collecting pollen

Petri dishes, glass cells and cover glasses for making hanging drop cultures, and a compound microscope. The materials used were Bordeaux 3-4-50; 5-6-50; and 4-4-50 , self boiled lime-sulphur 8-8-50; Commercial lime-sulphur 1-40; soluble sulphur 1 pound to 50 gallons nicotine 40% 1 to 800; and sulphur dust. Cane sugar solution 2% strength was used as the media for the drop cultures.

The cherry tree was the first to bloom, the first blossoms appearing on the 6th.of February and these blooms were fully opened on the 8th. Other blossoms on the same tree followed rapidly until the 14th when the last flower became full blown . As each blossom became full blown it was given a thorough spraying with one of the above mentioned fungicides, with the exception of a few clusters which were hand pollinated and left as checks. On the day after spraying pollen was collected with a brush from each of the sprayed flowers the stigma at the same time being pollinated with sprayed pollen, and the pollen is placed immediately in duplicate hanging drop cultures. These cultures were examined three times at intervals of twenty-four hours , estimates of the percent of germination being recorded at each examination. Sprayed and check flowers were carefully tagged to avoid all chance of error. The flowers were examined to note the effect of the spray on the stigma, and later the percent of fruit set was recorded.

- Experimental Records -

Tree No. 1. Cherry.

Cluster No. 1. Check Pollinated 3/8/15.
Plated 3a - 3b, 3/9/15.

Culture 3a.

24 hours. 30% germination. Most tubes short.

48 hours. 70% germination. Most tubes short but appear healthy and normal.

72 hours. 75% germination. Tubes as above.

Culture 3b.

24 hours. 15% germination. Most tubes short, some 6 to 8 times length of grain. Granular masses appeared about grains.

48 hours. 50% germination. All tubes short, but healthy and normal.

72 hours. 75% germination. All tubes short but seem normal.

Cluster No. 9. Check. Pollinated 3/14/15.
Plated 12a - 12b, 3/14/15.

Culture 12a.

24 hours. About 75% germination, long healthy tubes.

48 hours. No further germination.

72 hours. Impurity of culture prevented further germination.

Culture 12b.

24 hours. About 50% germination, tubes not as long as in 12a.

48 hours. No further germination.

72 hours. Culture showed same results as 12a.

Cluster No. 2. Sprayed with 4-4-50 Bordeaux, 3/8/15.
Pollinated 3/8/15
Plated 1a and 1b, 3/9/15.

Culture 1a.

24 hours. 8 to 10% germination, tubes very short, but one or two fo them ten times the width of the grain.

48 hours. 30% germination, tubes very short.

72 hours. No further germination.

Culture 1b.

24 hours. No germination.

48 hours. About 5% germ. with very short tubes.

72 hours. 25% just starting.

Cluster No. 5. Sprayed with self boiled lime and sulphur. 2/8/15.
Pollinated 2/8/15.
Plated 2a and 2b, 2/9/15.

Culture 2a.

24 hours No germination.

48 hours. No germination.

72 hours. No germination. About 2% show appearance of starting thubes.

Culture 2b.

24 hours. About 10% have started to send out tubes only one tenth of which have tubes longer than the width of the grain. This small percentage of tubes seems normal.

48 hours. No further germination noticeable. Those already germinated appear normal.

72 hours. No further germination.

Cluster No. 5. Sprayed with soluble lime and sulphur . 2/9/15.
Pollinated and plated 7a - 7b, 2/10/15.

Culture 7a.

24 hours. About 5% germination, with long healthy tubes.

48 hours. About 10% germination, tubes longer than in any other culture.

72 hours. At least 30% have germinated with very long tubes.

Culture 7b.

24 hours. About 4 - 5% germ. with long healthy tubes.

48 hours. No further germination.

72 hours. No further change in germination.

Note: The petals were badly burned by the spray solution.

Cluster No. 4. Sprayed with nicotine 2/9/15.
Pollinated and plated 6a - 6b
2/10/15.

Culture 6a.

24 hours. About 30% germination, tubes healthy and normal.

48 hours. No further germination, but tubes are usually very long, 20 - 30 times the length of the grain, and appear normal.

72 hours. Conditions the same.

Culture 6b.

24 hours. No indications of germination.

48 hours. No indications of germeination.

72 hours. No indications of germination.

Cluster No. 6. Sprayed with 3-6-50 Bordeaux
2/11/15.
Pollination and Plated 9a - 9b
2/12/15.

Culture 9a.

24 hours. Less than 1% germination. A very small number show any indication of germination.

48 hours. No further germination.

72 hours. No further germination.

Culture 9b.

24 hours. No indication of germination.

48 hours. No indication of germination.

72 hours. No indication of germination.

Cluster No. 7. Sprayed with dilute commercial lime and sulphur.
Pollinated and Plated 10a - 10b
2/12/15.

Culture 10a.

24 hours. No indication of germination.

48 hours. No indication of germination.

72 hours. Less than 1% germination.

Culture 10b.

24 hours. Less than 1% show germination of moderately long tubes.

48 hours. 4 - 5 % germination.

72 hours. No further indication of germaination.

Note: Blossoms badly burned in all cases.

Cluster No. 8. Dusted with powder sulphur 2/13/15. Pollinated and plated 11a - 11b, 2/14/15.

Culture 11a.

24 hours. About 5% germination.

48 hours. No further germination.

72 hours. Same.

Culture 11b.

24 hours. No germination.

48 hours. Same.

72 hours. Same.

Cluster No. 2 (Tree Number Two, peach).

Check. Pollinated and Plated 5a - 5b , 2/19/15.

Culture 5a.

24 hours. About 80% germination.

48 hours. No further indication of germination, but the tubes still healthy but rather short. Mostly not over the length of width of the length of the grain.

72 hours. No further indication of germination.

Culture 5b.

24 hours. About 50% germination. Tubes not very long.

48 hours. Fully 90% germination, with very long tubes

which are 30 - 30 times the length of the grain.

72 hours. No further indication of germination.

Cluster No. 5. Check. Pollinated and plated 15a - 15b 2/16/15.

Culture 15a.

24 hours. About 80% germination.

48 hours. About 95% germination, mostly with short tubes.

72 hours. No changes in germination.

Cluster No. 1. Sprayed with Bordeaux 4-4-50, 2/8/15.
Pollinated and plated 4a - 4b, 2/9/15

Culture 4a.

24 hours. No germination but some indication in some grains.

48 hours. No further germination.

72 hours. Same.

Culture 4b.

24 hours. No indication of germination.

48 hours. Same.

72 hours. Same.

Cluster No. 3. Sprayed with 3-6-50 Bordeaux, 2/11/15.
Pollinated and plated 8a - 8b, 2/12/15.

Culture 8a.

24 hours. No germination.

48 hours. Same.

72 hours. Same.

Culture 8b.

24 hours. About 1% germination, several with very long tubes.

48 hours. Same conditions.

72 hours. " "

Cluster No. 4. Sprayed with self boiled L-S 2/13/15. Pollinated and plated 13a - 13b, 2/15/15.

Culture 13a.

24 hours. No indication of germination.

48 hours. Same.

72 hours. Same.

Culture 13b.

24 hours. No indication of germination.

48 hours. About 1% germination.

72 hours. No further germination.

Tree No. 3. PLUM.

Cluster No. 2. Check . Pollinated and plated 18a - 18b 2/18/15.

Culture 18a.

24 hours. 15% germination.

48 hours. 40% germination mostly short tubes.

72 hours. 75% germination, tubes very short.

Culture 18b.

24 hours. 25 - 30% germination.

48 hours. 60% germination. Mostly very short.

72 hours. 80% " . Little change in length of tubes.

Cluster No. 1. Sprayed with self boiled lime sulphur 2/15/15. Pollinated and ~~sprayed~~ plated 14a - 14b, 2.16.15.

Culture 14a.

24 hours.

48 hours. No germination.

72 hours. 15% germination.

Culture 14b.

24 hours.

48 hours. no indication of germination.

72 hours. 10% germination.

Tree No. 4. PEACH.

Cluster No. 3. Check. Pollinated and plated 17a - 17b 3/18/15.

Culture 17a.

24 hours. 60% germination just started.

48 hours. 75% germination none with tubes longer than gzain.

72 hours. No further change, mold contaminated the culture.

Culture 17b.

24 hours. 50% germination.

48 hours. No further change.

72 hours. 80% germination, mostly short tubes.

Cluster No. 1 Self boiled lime-sulphur. sprayed 3/16/15. Pollinated and plated 16a - 16b, 3/17/15.

Culture 16a.

24 hours. About 1% germination long healthy tubes.

48 hours. About 5% germination

72 hours. 30% germination, short tubes.

Culture 16b.

24 hours. Less than 1% germination.

48 hours. About 1% germination.

72 hours. No further germination.

Tree No. 5. PLUM.

Cluster No. 1 Check. pollinated and plated. 19a - 19b, 3/17/15.

Culture 19a.

24 hours. About 85% to 90% germination.

48 hours. 95% germination, long healthy tubes.

72 hours. No further changer

Culture 19b.

24 hours. 50% germination.

48 hours. 80% germination medium length tubes

72 hours. % same, tubes longer.

Cluster No. 2. Sprayed 3-6-50 Bordeaux , 2/27/15.
Pollinated and plated 21a - 21b,
2/28/15.

Culture 21a.

24 hours. No germination.

48 hours. About 5% germination, very short tubes.

72 hours. No change.

Culture 21b.

24 hours. 1% germination very short tubes.

48 hours. No further change.

72 hours. No change.

Cluster No. 3. Sprayed with self boiled L-S
2/27/15.
Pollinated and plated 22a - 22b,
2/28/15.

Culture 22a.

24 hours. About 5% germination.

48 hours. No change.

72 hours. No change.

Culture 22b.

24 hours. No germination.

48 hours. No germination.

72 hours. About 1% starting.

Cucumbers:

Series No. 3. Check. Pollinated and plated 3/1/15
24a - 24b.

Culture 24a.

24 hours. 50% germination just starting.

48 hours. 80% germination not increased in length

Culture 24a.

72 hours. No change.

Culture 24 b.

24 hours. 75% germination 10% long tubes.

48 hours. 90% , no increase in length.

72 hours. No change.

Series No. 4. Check. Pollinated and plated 25a - 25b, 3/2/15.

Culture 25a.

24 hours. 25 % germination just started.

48 hours. 75% germinated very short tubes.

72 hours. 80% germination.

Culture 25b.

24 hours. No germination.

48 hours. 10% just started.

72 hours. Condidions the same.

Series No. 15. Check. Pollinated and plated 36a - 36b. 3/10/15

Culture 36a.

24 hours. About 60% with short tubes.

48 hours. No change.

72 hours. No change: Culture much contaminated.

Culture 36b.

24 hours. About 50% germination with short tubes.

48 hours. " 50% " " " "

72 hours. No change in germination with a slight budding.

Series No. 1. Sprayed with 3-6-50 Bordeaux , 2/26/15.
Pollinated and plated 20a - 20b, 2/27/15.

Culture 20a.

24 hours. No germination.

48 hours. No germination.

72 hours. No germination.

Culture 30b.

24 hours. No germination.

48 hours. No germination.

72 hours. No germination.

Series No. 2 — Sprayed with 3-6-50 Bordeaux - 2/27/15. pollinated and plated 23a - 23b, 3/1/15.

Culture 23a.

24 hours. No germination.

48 hours. No germination.

72 hours. No germination.

Culture 23b.

24 hours. No germination.

48 hours. About 1% have just started.

72 hours. No further germination.

Series No. 5. — Sprayed with 4-4-50 Bordeaux, 3/2/15. Pollinated and plated 26a - 26b, 3/3/15.

Culture 26a.

24 hours. About 5% have just started.

48 hours. No further change.

72 hours. Same.

Culture 26b.

24 hours. Less than 1% have just started.

48 and 72 hours . Same.

Series No. 6. Sprayed with 4-4-50 Bordeaux, 3/3/15. Pollinated and plated 27a - 27b, 3/4/15.

Culture 27a.

24 hours. Germination less than 1% with very short tubes.

48 hours. No further change.

72 hours. " " " .

Culture 27b.

24 hours. No germination.

48 hours. About 10% have just started.

72 hours. No further change.

Series No. 7. Sprayed with self boiled L-S 3/4/15. Pollinated and plated 28a - 28b, 3/5/15.

Culture 28a.

24 hours. About 1% have just started.

48 hours. 5% have just started, no more growth than at 24 hours.

72 hours. No increase in germination.

Culture 28b.

24 hours. Less than 1% germination.

48 hours. No increase in germination.

72 hours. " " " " .

Series No. 8. Sprayed self boiled L-S , 3/7/15. Plated 29a and 29b, 3/8/15.

Culture 29a.

24 hours. 50% show first signs of germination.

48 hours. No further change in germination.

72 hours. Same.

Culture 29b.

24 hours. About 30% show first signs of germination.

48 hours. No further change.

72 hours. Same.

Series No. 9. Sprayed with dilute commercial lime and sulphur , 3/8/15. Plated 30a and 30b, 3/9/15.

Culture 30a.

24 hours. 50% show signs of germination, but barely 1% show much growth.

48 hours. All failed to germinate further.

72 hours. No further germination.

Culture 30b.

24 hours. 25% show signs of germination, but barely 1% show much growth.

48 hours. All failed to germinate further.

72 hours. Same.

Series No 10. Sprayed with 2-4-50 Bordeaux ,3/8/15. Plated 31a and 31b, 3/9/15.

Culture 31a.

24 hours. 5% have just started to germinate.

48 hours. 5% have made a very weak growth.

72 hours. 30% show apparent buds at extremities, but no growth.

Culture 31b.

24 hours. 5% have just started to germinate.

48 hours. No further change in germination.

72 hours. Same.

Series No. 13. Sprayed with 2-4-50 Bordeaux 3/9/15 Plated 34a and 34b, 3/10/15.

Culture 34a.

24 hours. Less than 1% have germinated with very short tubes.

48 hours. Slight budding in 50% , otherwise no change.

72 hours. No further change.

Culture 34b.

24 hours. About 5% have just started to germinate.

48 hours. No further change. There is much impurity present in the culture.

72 hours. No complete germination. Slight budding in some cases.

Series No. 13. Sprayed with dilute commercial lime and sulphur, 3/9/15.
Plated 33a and 33b. 3/10/15.

Culture 33a.

24 hours. No germination.

48 hours. Same.

72 hours. Same, budding prominent.

Culture 33b.

24 hours. No germination.

48 hours. " "

72 hours. " "

Series No. 11. Dusted with dry sulphur , 3/8/15.
Plated 32a and 32b, 3/9/15.

Culture 32a.

24 hours. No germination . Much dust present in the culture.

48 hours. No germination.

72 hours. No change except slight budding.

Culture 32b.

24 hours. About 1% starting. Much sulphur dust present in the culture.

48 hours. No germination.

72 hours. No change except slight budding.

Series No. 14. Dusting with sulphur. 3/9/15.
Plated 35a and 35b, 3/10/15?

Culture 35a.

24 hours. No germination.

48 hours. Same.

72 hours. 1% have developed short tubes.

Culture 35b.

24 hours. No germination.

48 hours. Same.

72 hours. 1% have developed short tubes. Some sulphur dust present.

Series No. 15. Sprayed with Nicotine 3/16/15. Plated 37a, 37b, 38a, and 38b. 3/17/15.

Culture 37a.

24 hours. About 60% have started to bud, but none have made much growth.

48 hours. About 50% have developed short tubes.

72 hours. No further change in germination.

Culture 37b.

24 hours. About the same condition as 37a.

48 hours. About the same as 37a.

72 hours. No further change in germination.

Culture 38a.

24 hours. About 80% have budded and about 5% have sent out tubes as long as the grain is wide.

48 hours. About 40% have germinated with short tubes.

72 hours. No further change in germination.

Culture 38b.

24 hours. About 80% have budded but none have short tubes.

48 hours. About 60% have germinated with short tubes.

72 hours. No further change in germination.

In all cases a number of flowers were sprayed with each solution, and the mixed pollen from all of them plated.

On February 26th, trees number 1, 2, and 3, were

examined to ascertain the percent of fruit which had set on the sprayed and the check blossoms. Trees number 4 and 5 were similarily examined on March 16th. Owing to the fact that male blossoms only were sprayed on the cucumbers, there was no necessity or possiblity of obtaining data on the setting of fruit. The following results were obtained:-

Tree Number 1. Cherry.

Spray	Total Sprayed	Total Set.	Per Cent.
Check	24	5	38.3
Nicotine	41	0	0.0
3-6-50 Bordeaux	22	1	4.5
4-4-50 "	14	0	0.0
Dust	31	0	0.0
Soluble Sulphur	32	0	0.0
Dilute L*S	18	0	0.0
Self Boiled L-S	15	0	0.0

Tree Number 2. Peach.

4-4-50 Bordeaux	8	5	62.5
Check	12	11	91.6
Self Boiled L-S	4	4	100.0
3-6-50 Bordeaux	2	1	50.0

Tree Number 3. Plum.

Check	5	2	40.0
Self Boiled L-S	2	0	0.0

Tree Number 4. Peach.

Self Boiled L-S	2	2	100.0
Check	6	5	83.3

Tree Number 5. Plum.

3-6-50 Bordeaux	6	5	83.3
Self Boiled L-S	7	5	71.4
Check	11	9	81.8

Owing to the fact that the experiment was carried on under greenhouse conditions, we do not consider that much importance should be placed on the data for fruit setting, as it is , especially in the case of the last three trees, rather inconclusive. The cherry tree, however, substantiates,

in the amount of fruit set, the results found in the examination of the pollen. All blossoms were unprotected from pollination from unsprayed flowers, and this is doubtless the reason why , in the case of the other trees, the results do not bear out the germinating powers of the pollen. The sprayed blossoms which set fruit were doubtless pollinated by wind or insects by pollen from the unsprayed trees. However, the fact that so many sprayed flowers set fruit seems to indicate that the spray had no injurious effect upon the stigma.

- Conclusion -

The results seem to indicate that all fungicidal sprays have an inhibitive effect on the germination of pollen, although the different fungicides vary in the degree of this effect. The figures on the germination of check pollen bear out this statement very strikingly, the checks germinating from 23.5% in 24 hours in the case of plum pollen, to 71.3% in 24 hours in case of the peach. This percentage increased in 48 hours from a minumim of 50.0% in case of the plum, to a maximum of 88.7% in the peach. This probably is the extreme limit of time for the usefulness of the pollen to the flower as pollen germinating after this time will probably miss the best receptive period of the stigma. Between 48 hours and 72 hours we find that there is some increase in certain cases, the mimumim percentage for this last period being 61.6% in the cucumber, and a maximum of 91.6% in case of the peach. On the other hand, the best germination of sprayed pollen was 15% in the case of cherry treated with nicotine, not truly a fungicide, at the end of 24 hours , and 5% in the case of cherry sprayed with self boiled L-S and 4-4-50

Bordeaux at the end of the same period. The highest germination attained by sprayed pollen for any period was 22.5% in a culture of cherry pollen sprayed with 4-4-50 Bordeaux after a period of 72 hours. Other results are much lower than these cited, a number of them showing under 1% of germination during the entire period.

The safest fungicide to use, everything else being equal to obtain the largest yield, would be self boiled lime and sulphur, followed closely by 4-4-50 Bordeaux. The latter, however, seems to have an especially inhibitive effect on peach pollen, 3-6-50 Bordeaux and self boiled lime and sulphur being about equal for this tree. All sprays seem to have an especially injurious effect on cucumbers, the best percentage being obtained from 2-4-50 Bordeaux very nearly the same. Spraying in bloom , however, can be expected to reduce the yield under the best of conditions, whatever the fungicide used. With Reference to the spraying of cucumbers, we could recommend the avoidance of bloosom spraying in so far as it is compatible with the control of disease.

- Summary -

1. This thesis records field observations and treatment of the following diseases and insects: Downy Mildew, Scab, Anthracnose, White Pickle, Angular or Bacterial Leaf Spot, Fusarium Wilt, and Black and Green Aphis.

Experiments were also conducted on the fungicidal effect on the germination of pollen.

2. Bordeaux 3-6-50 proved an absolute control for the Downy Mildew.

3. Bordeaux 3-6-50 proved a decided check upom the development of scab.

4. Bordeaux 3-6-50 proved to be an efficient economic control for anthracnose but it does not effect complete prevention.

5. Bordeaux 3-6-50 does not prevent, or check in anyway the trouble called White Pickle.

6. Bordeaux 3-6-50 effects a partial control of the trouble called Angular or Bacterial Leaf Spot.

7. Bordeaux 3-6-50 seems to effect an apparent control of a trouble called in the above description Fusarium Wilt.

8. Aphis are easily controlled by nicotine sprays of the proper strength the difficulty being to reach all of the insects on the under side of the leaves with the spray.

9. Field observations seemed to indicate that spraying with fungicides interferes with the setting of the fruit in some cases.

10. This supposition is borne out by experiments in the greenhouse.

11. Further field experimentation is necessary in order to substantiate the injurious effects of fungicides upon the setting of the fruit.

- Recommendations. -

1. In regions where the Downy Mildew, Scab, Anthracnose, and Angular (Bacterial) Leaf Spot, are present spraying with Bordeaux will undoubtedly pay in most seasons.

2. For white pickle, and fusarium wilt spraying with Bordeaux is not a good economic practice.

3. In the cases of diseases that can be controlled by spraying it is the best practice to have the plants protected by the spray before the diseases appear in the patch. This becomes essential in the control of Downy Mildew and Scab.

4. In order to obtain accurate and complete results such experiments should be conducted upon demonstration plots owned by the company.

Name.	NO of gals to ea. spray. 1	2	3	4	5	6	Total	A. Sp.	Gal. per A.	Av. gal to ea. Spray.
1. Vandenburg	75						75	.625		
2. Rhoades	35	30	35	50			140	.18		
3. Moore	90	100	80	120			390	.535		
4. Larson	75	65	70	140	130		480	.653		
5. Libby	25	30	30				85	.125		
6. Cannan	15	15	15	25	40	40	135	.125	1160	193
7. Martin	40	45	50	70	90	80	385	.27	1425	237
8. Smith	35	40	35	45	60	50	265	.205	1297	215
9. Irish	15	20	20	30			85	.067		
10. Schramm	15	20	25	40			95			
11. Lilly	75	50	110	125	125	110	595	.464	1280	213
12. Stokes	40	40	40	40	45	45	250	.228	1096	188
13. Langworthy	30	30					60	.14		
14. Troupe	20	20	35	45	50	40	210	.238	882	143
15. Gordon	80	75	90	100			435	.473		
16. Welcome			50	90			140	.50		
Total ----------							3710	5.068		1183 or ave of 197 gals.

Average number of gals. per Acre on patches sprayed six times in 197 gallons.

-Cost of spraying -

Lime for 50 gallons --------	$0.03
$CuSO_4$ for 50 gallons -------	0.21
Cost per bbl. --	.24
Cost per acre --	$ .96

PART III

Spraying in Bloom in the Field.

With a view of supplementing the work done in the greenhouse, experiments were made under field conditions, on apple, cherrry, plum, peach, and pear trees in the orchard. When these trees were in full bloom, they were sprayed with five different fungicides and insecticides as follows:- Bordeaux mixture, 4-4-50, soluble lime sulfur, summer strength, commercial lime sulfur, summer strength, self-boiled lime sulfur, 8-8-50, and nicotine solution. The number of blossoms sprayed with each of these sprays were recorded and the number of fruits set were counted five to six weeks later. Check branches were counted and left unsprayed for each variety of fruit worked with. Owing to the great inclemency of the weather during the entire time of the experiment, many blossoms did not set fruit which might have done so under more favorable weather conditions, and for this reason the results shown below are more or less inconclusive. Fruit

Summary.

The results shown in the above table in some measure prove the conclusions reached from the work in the greenhouse, but on account of the unfavorable weather conditions which interfered with the normal setting of fruit, they cannot be stated as being conclusive.

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